TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION

UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Thinning of Conifer Seedlings in the Nursery Produces Bigger But Fewer Plantable Trees

n order to determine whether late spring thinning of seedlings in dense seedbeds s feasible, an experiment was laid out in June 1937 at the Hugo Sauer Nursery, hinelander, Wisconsin, in third-year seedlings of white and red pine.

ffect of Thinning on Size

Seedlings growing at a density of 125 per square foot were root-pruned at depth of $3\frac{1}{2}$ to 4 inches and thinned to 25, 50 and 75 per square foot in the atter part of June.

Measurements taken at the end of the 1937 growing season are shown for the hite pine in the following table:

Density per sq. ft. in seedbed	Top length (Inches)	Root length (Inches)	Stem diameter in 64ths of an inch	Green weight (Grams) Total plant	Top	Root	Top-root ratio (Based on green weight)
25	7.42 ± 1.69	10.60 ± 2.50	8 ± 2.38	5.58	4.36	1.22	3.58 - 1
50	7.36 ± 1.36	9.08 ± 2.16	7 ± 1.31	4.30	3.52	.77	4.59 - 1
75	7.10 ± 1.35	7.64 ± 2.73	7 ± 1.26	3.33	2.61	.72	3.63 - 1
125	7.38 ± 1.73	7.36 ± 2.28	6 ± 1.61	3.55	2.90	.64	4.51 - 1

Based on samples of 25 trees from each density.

It will be seen that the thinning benefited the stock by increasing its average weight and stem diameter.

Effect of Thinning on Number of Plantable Trees

However, an entirely different picture of the value of the thinning is obtained by computing the number of plantable trees produced per square foot as shown by the table below.

Density per sq. ft. in seedbed	Number of trees per square foot of seedbed by stem diameter classes: 5/64 inch or over		6/64 inch or over		7/64 inch or over		8/64 inch or over	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
25	24	96	22	88	19	76	16	64
50	46	92	44	88	26	52	18	36
75	72	96	60	80	33	44	21	28
125	110	88	95	76	40	32	35	28

Based on samples of 25 trees from each density.

The table shows a greater number of plantable trees per square foot in the unthinned beds, regardless of what is set up as the minimum acceptable stem caliper. The 3-0 red pine showed the same general trend.

The conclusion is that thinning of white or red pine seedlings in late spring of the third year is not justified by the results obtained and it appears that such thinning if necessary should be done not later than the spring of the second year. The results emphasize the advisability of attaining the desired density by reducing the amount of seed, rather than resorting to thinning.

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U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 144

Beneficial Effect of Partial Shade on Field Survival

The beneficial effect of a partial overhead cover on initial field survival of conifer stock is quite generally recognized. This is especially true on well-drained sandy soils and during extreme drought periods, where first-year growth as well as field survival is usually greater for areas under a partial overhead cover than for open areas.

Evidence obtained from two experimental plots established on the Nicolet National Forest, Wisconsin, in the spring of 1937, confirms earlier findings. The soil in both plots was a loamy fine sand with a sandy subsoil, and since they were almost contiguous, no doubt received about the same amount of rainfall. One area was open in character, with a heavy sod cover, while the other supported a uniform cover of aspen saplings 1-4 inches in diameter breast height, with an average density of about 1,000 trees per acre after furrowing. The average light intensity in midsummer was 75 percent of full sunlight at breast height and 56 percent at 4 inches above the ground level. A variety of age classes of jack and red pine were planted on both areas, with the results obtained at the end of the first year as follows:

Species planted	Age class	Open area, light intensity 100 percent: Survival percent	Average total ht. at end of season (Inches)	Average seasonal growth (Inches)	Area with aspen cover, light intensity 56 percent: Survival percent	Average total ht. at end of season (Inches)	Average seasonal growth (Inches)
Jack pine	1-0	29.2	2.8	0.6	61.5	3.8	1.6
" "	2-0	29.8	5.6	1.9	70.3	7.8	4.1
" "	1-1	33.2	5.4	2.1	76.8	8.6	5.3
Red pine	2-0	14.5	3.6	1.4	55.6	4.3	2.1
" "	2-1	16.1	5.0	0.5	59.1	7.0	2.5
" "	2-2	44.9	11.1	2.4	71.3	11.6	2.9
Basis (number of trees 1/)		4,039	158	158	2,873	87	87

1/ There were ten replications in each species and age class.

The highly significant difference in survival on the two areas clearly indicates the value of the aspen cover in securing good initial survival. Soil moisture conditions, as determined by periodic sampling during the whole season, were slightly better on the open area than in the aspen-covered area, due principally to some interception of the rainfall and use of soil moisture by the overhead cover. Since the chief cause of mortality in both areas was drought, it must be concluded that trees planted under cover use less soil moisture, due to reduction of transpiration, than those planted in the open.

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Top-Pruning of Conifer Stock a Doubtful Operation

Top-pruning of conifer nursery stock is supposed to increase field survival by reducing the transpiration rate. However, if the pruning is done immediately before planting, it is more harmful than beneficial.

op-Pruning Immediately Before Planting

In the spring of 1937, an experimental plot was established on the icolet Forest to test the effects of top-pruning 2-0 jack pine just prior to lanting. One-third of the trees were pruned by severing the top one-half nch below the terminal bud, and approximately the same number were pruned by utting the top back to a three-inch length.

Class of stock planted	Percent surviving	Percent dead			Basis[1] (Number of trees)
		Grubs	Drought	Missing	
ot pruned	73.0	1.5	22.2	3.3	1,000
runed to point ½ inch below terminal bud	57.6	1.0	25.0	16.4	978
runed to a 3-inch top	51.9	1.4	28.9	17.8	1,000

1/ There were 10 replications of each lot, generally of 100 trees each.

The results obtained clearly show the disastrous effects of top-pruning hen done just prior to planting. It is believed that most of the trees classi- ied as "missing" died in early summer and thus disappeared.

op-Pruning in Considerable Advance of Planting

Another test of top-pruning was made in 1937 and 1938 to determine hether earlier pruning would be equally disastrous. Four lots of 2-0 jack pine t Hayward Nursery were top-pruned on July 6 of the second growing season at eights of 4, 6, and 8 inches respectively, with one lot left unpruned. The rees appeared to recover quite well by the end of the season and were planted n the Hoquah District in the fall, 1937. Survival counts made in fall, 1938 re given below.

Plot	Degree of pruning			
	Not pruned	Pruned to 8-inch top	Pruned to 6-inch top	Pruned to 4-inch top
	Survival percent			
lot 1	92.7	92.7	94.8	89.8
lot 2	95.1	97.7	94.5	90.1

In both plots there were 5 replications of each lot, with 100 trees each.

Top-pruning clearly failed to produce an increase in field survival. If op-pruning is necessary to prevent overwinter snow lodging of fall-planted rees, the stock should under no circumstances be top-pruned to closer than a ix-inch top.

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Black Spruce Maintains a Year-Round Seed Supply

When the cones of black spruce mature they remain attached to the trees for ny years, unlike the cones of most native conifers which fall to the ground with- a relatively few weeks or months. This fact suggested the possibility that the eds might be held in the cones for several years.

In September 1936, all the cones, old as well as freshly ripened, were cked from 25 trees that had previously been selected as representative sample the seed-producing trees in a swamp stand. Similar collections were made from upland stand. The results are shown in the table below. The same determina- ons were made for new and 1-year-old cones in 1937 and again in 1938. The test- g of old cones was not repeated because it was extremely tedious to separate the eds from bits of cone scales that broke up and mixed with the seeds during the traction process.

It appears that a very considerable portion of the seed remains in the cones r a year or longer.

Amount of Seeds in Cones on Living Trees

Date of ollection	M seeds per acre					
	New cones		Cones 1 year old		Cones more than 1 year old	
	Swamp	Upland	Swamp	Upland	Swamp	Upland
ptember 1936	416	2,533	321	768	429	632
ptember 1937	385	375	313	467	No data	
ptember 1938	89	735	147	509	No data	

Afterwards, germination tests were made which indicated that there was some wering in viability with increasing age but a good proportion of the oldest lots re still capable of germination.

Both jack pine and black spruce maintain a reserve supply of seed but by fferent methods. Most jack pine cones remain completely closed, whereas black ruce cones begin to open immediately after ripening, but complete opening is layed and the distribution of seed is extended over a considerable period.

Another peculiarity of black spruce seed is that it falls throughout the tire year, rather than at some particular time Records from seed traps which ve been in operation for 2 to 4 years indicate that 37 percent of the seed fall curred in the late fall and winter months October to April; May, June, and July counted for 38 percent, and August and September for 25 percent.

The practical significance of this information is that regardless of the me of year at which black spruce timber is cut, there is likely to be a good pply of seed on the ground.

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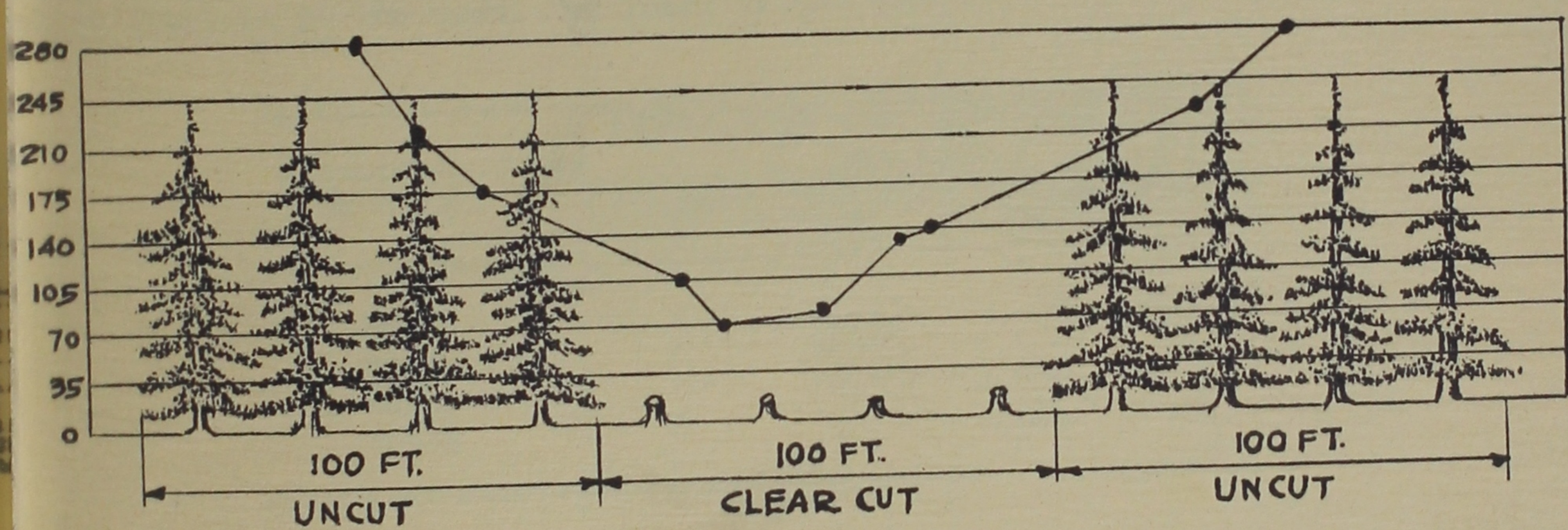
Black Spruce Seed Is a Limited Air Traveler

It would be reasonable to suppose that black spruce seeds, which are extremely ll, would be widely scattered by wind when they are released from the cones. How- r, seed distribution records, obtained by means of seed traps on the Superior ional Forest, indicate that only a very small proportion of the seed travels more n 100 feet from the edge of a black spruce stand.

In one test, seed traps were placed in a clearing at various distances to northeast from the edge of a stand and the seed was collected from the traps for eriod of two years. The prevailing wind direction being southwest in this ality, the seeds should fly farther to the northeast than any other direction. results are given in the table.

Distance from edge of stand (feet)					
hin stand	10	80	160	240	320
Seeds per acre per year					
300,000	84,000	24,000	12,000	6,000	0

In another test, seed traps were set out in an experimental cutting where ·ips 100 feet in width had been cut clear and alternate strips of the same width l been left undisturbed. The basis for the data given in the figure is a record the total seed fall for three years.



It is likely that when wind or air currents are just right, some seeds avel much farther than these data indicate, but it is evident that as a seed ee, black spruce cannot be depended upon to scatter enough seed to insure natural production for distances of more than 100 feet.

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Jack Pine Seed Habits

That jack pine seed ordinarily is dispersed for only a very limited distance is illustrated by results of a study initiated near Roscommon, Michigan. During August 1937, a jack pine seed tree 45 years old, 7.5 inches in d.b.h., and 34 feet tall was burned. The seed fall was measured under the tree and at distances of 1/4, 1/2, and 1 chain away from the tree in each of the four cardinal directions.

The following facts were gleaned from these data:

1. Seed fall was only moderately heavy during the ten days immediately following burning (3,690 per acre), and continued at about the same average rate between 10 and 40 days after burning (11,070 per acre). Between 40 and 70 days after burning, seed fall diminished greatly (1,230 per acre) and was probably very nearly completed.

2. The distance to which seed was carried in this case was limited to about 1 chain, or twice the height of the seed tree. During the period of observation, wind velocity at a height of 35 feet did not exceed 13 miles per hour. The average data indicate a fall of 68,000 good seed per acre under the tree, 19,000 per acre at 1/4 chain, 15,000 at 1/2 chain, and only 1,000 per acre at 1 chain away from the tree.

3. Direction as well as distance influences the amount of seed falling in a given spot. The prevailing winds, which in this locality were largely west and southwest, are reflected in the seed dispersal (see table below), which is greatest to the east of the seed tree, next greatest to the north, third greatest to the west, and least to the south.

Directions from seed tree	Number good jack pine seed falling per acre			
	Distance from seed tree in chains			
	0	1/4	1/2	1
East	68,000	44,000	40,000	4,000
North	"	28,000	8,000	0
West	"	4,000	8,000	0
South	"	0	4,000	0

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When Do Jack Pine Seeds Germinate?

Since studies of cone opening in jack pine slash have shown that most of the seeds escape during the hotter periods in July and August, it is important to know when seeds that escape at this time are most likely to germinate. Do most of them germinate promptly, or are they likely to remain dormant until the following spring?

In a field study conducted on the Superior National Forest, it was found that where moisture conditions were favorable, jack pine seeds germinated actively whenever the maximum air temperature exceeded 64° F. At Ely, Minnesota this period extends roughly from May 10 to October 1.

In the experiment, seeds were sown both in coarse, poorly decomposed litter and in rather finely divided, torn-up litter at 11 different dates extending over a 12-month period. The scarified litter plots were shaded with crisscrossed sticks to simulate logging slash.

On these shaded plots, all lots of seed germinated readily when the 10-day average maximum air temperature reached 64° F. and over. Germination ceased when this temperature dropped below 64° F.

The seeds on unshaded, coarse litter plots, on the other hand, germinated very little until the following May when the high moisture content caused by the recently melted snows and spring rains kept the ground moist for a long enough period to permit active germination.

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No. 150

Effect of Utilization Standards on Pulpwood Yield

The effect of different utilization standards on the volume of pulpwood obtained from trees of different diameters was determined in a recent study conducted on the Superior National Forest. A stand of jack pine was cut into 100-inch bolts with a minimum top-diameter limit of 3 inches. When stacked, there were 155 cords of wood meeting the 3-inch-top specification. If the trees had been cut to top-diameter limits of 4, 5, or 6 inches, the losses indicated in the table below would have resulted, loss being considered to be the difference between the yield to a 3-inch top and to a 4-, 5-, or 6-inch top.

D.B.H. of trees	Minimum top diameter (i.b.)		
	4 inches	5 inches	6 inches
Inches	Loss in percent		
5	40.0	100.0	100.0
6	22.5	57.8	100.0
7	12.5	35.0	74.0
8	7.8	22.7	50.0
9	4.5	14.0	22.5
10	2.0	7.5	18.4
11	0.5	2.9	8.0
12	0	0	1.0

The average loss per acre depends upon the distribution of diameter classes, but it is very apparent that a slight change in utilization limits may make a considerable change in volume of pulpwood produced, particularly in small stands.

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Comparative Resistance of Native Wisconsin Trees to Snow Breakage

On October 21 and 22, 1938, a heavy snowstorm struck the northern part of Wisconsin and provided an excellent opportunity to study comparative resistance of different species to snow breakage, uprooting, and bending. An estimate of the damage to the different species by size classes was made a few days after the storm, and is listed below Figures were also obtained from the Chequamegon and Nicolet National Forests The damage was aggravated by the wet condition of the snow and by a high wind which accompanied the storm. The snow on the level was as much as 1 foot deep in some areas.

Species	0- to 4.5-inch d.b.h.		4.5- to 9.0-inch d.b.h.		9.0- to 24.0-inch d.b.h.	
	Percent broken	Percent uprooted or badly bent	Percent broken	Percent uprooted or badly bent	Percent broken	Percent uprooted or badly bent
Conifers						
Black spruce	5	10	5	1	(1)	(1)
Tamarack	1	10	(1)	(1)	(1)	(1)
White cedar	2	10	1	3	(1)	(1)
Balsam fir	5	8	2	1	(1)	(1)
Hemlock	3	3	5	0	3	0
Jack pine	3	5	4	3	1	0
White spruce	1	2	3	1	10	(1)
White pine 2/	1	1	3	0	0	0
Red pine 2/	0	1	0	0	0	0
Broadleaf species						
Paper birch	4	8	4	1	1	0
Aspen	3	5	2	0	0.5	0
Hard maple	0.5	0	0.5	0	0	0
Red oak	0	0	0	0	0	0
Basswood	0	0	0	0	0	0

1/ No data.
2/ Some breakage of smaller limbs up to 1 or 2 inches in diameter.

The values represent average loss over an area extending from Eagle River to Hayward, Wisconsin. In some limited localities, loss was much more severe. For instance, black spruce in some poorly stocked swamps showed as high as 60 to 80 percent of the trees broken off at a height of 10 to 20 feet, and some white cedar swamps had as high as 30 percent of the trees uprooted. Where cedar was badly bent but not uprooted, practically all the trees straightened up. Hardwood poles, however, show no signs of straightening.

There is urgent need of prompt attention to individual tracts by cutting the broken and uprooted trees to salvage this material and reduce the fire hazard and unsightly appearance along roads. Considerable work has already been done along this line.

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul 1, Minnesota

A Fast-Growing and Winter-Hardy Poplar Hybrid Still to be Found for the Lake States

Widespread interest has been shown by foresters and farmers of the Lake States in the fast-growing poplar hybrids developed by the New York Botanic Garden and the Oxford Paper Company.

In 1935, ten of these hybrids were set out on the Chippewa National Forest in Minnesota and near Denbigh, North Dakota. All made excellent growth during the first summer, but at both locations they froze back to the snow line during winter. After four seasons in the field in Minnesota, the survival and heights by parentage were as shown below:

Male parent	Female parent	Survival	Average height
		Percent	Feet
P. berolinensis	P. angulata	58	8.3
Clone Eugenei	P. charkowiensis	33	7.3
P. trichocarpa	P. charkowiensis	31	8.9
P. laurifolia	P. nigra	23	7.7
P. laurifolia	P. nigra	13	6.0
P. berolinensis	P. maximowiczii	11	7.4
P. berolinensis	P. maximowiczii	5	7.7
P. laurifolia	P. nigra	10	6.8
P. berolinensis	P. maximowiczii	0	-
P. trichocarpa	P. maximowiczii	0	-

The first three have escaped frost injury during mild winters, but the last seven have been injured every year.

In 1938, fifteen additional hybrids were obtained from the Northeastern Forest Experiment Station. These have yet to survive their first winter; consequently their value for use in Minnesota is unknown.

It should be possible to find a poplar hybrid that will be resistant to Minnesota winters and yet make more rapid growth than the native aspen. However, the hybrids thus far tested hold out no promise.

Further tests with other hybrids will be continued.

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1/ Maintained by the United States Department of Agriculture at St. Paul, Minnesota, in cooperation with the University of Minnesota.

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No. 155

Taper Table for Jack Pine
(*Pinus banksiana*)
Lake States

D.B.H.	Total height	Diameter inside bark at height above ground of --										Basis
		5 feet	9 feet	17 feet	25 feet	33 feet	41 feet	49 feet	57 feet	65 feet	73 feet	
Inches	Feet	Inches										Trees
3	30	2.7	2.6	2.0	0.9							10
	40	2.8	2.7	2.5	2.0	1.2						23
	50	2.8	2.8	2.6	2.3	1.9	1.2					1
4	30	3.6	3.4	2.5	1.2							6
	40	3.7	3.5	3.1	2.4	1.5						33
	50	3.7	3.6	3.3	2.9	2.4	1.5					18
5	30	4.4	4.0	2.8	1.3							2
	40	4.5	4.2	3.7	2.9	1.8						22
	50	4.6	4.4	4.0	3.5	2.8	1.8					40
	60	4.6	4.5	4.1	3.7	3.2	2.7	1.8				2
6	40	5.3	5.0	4.2	3.3	2.1						18
	50	5.4	5.1	4.6	4.1	3.2	2.1					45
	60	5.5	5.3	4.9	4.4	3.8	3.1	2.1				13
7	40	6.2	5.7	4.8	3.8	2.4						6
	50	6.3	5.9	5.3	4.6	3.6	2.3	0.5				55
	60	6.4	6.1	5.7	5.1	4.4	3.6	2.4				52
	70	6.4	6.2	5.9	5.5	4.9	4.2	3.4	2.3			3
8	50	7.1	6.7	6.0	5.2	4.0	2.5	0.6				29
	60	7.2	6.9	6.4	5.8	5.0	4.1	2.8	1.0			40
	70	7.3	7.0	6.6	6.1	5.5	4.7	3.7	2.5	1.1		6
9	50	8.1	7.5	6.7	5.7	4.3	2.7	0.7				25
	60	8.2	7.8	7.2	6.4	5.5	4.5	3.0	1.2			35
	70	8.3	8.0	7.4	6.7	6.0	5.2	4.1	2.7	1.1		15
10	50	8.9	8.3	7.4	6.2	4.6	2.9	0.7				13
	60	9.1	8.6	7.8	7.0	6.1	4.9	3.3	1.2			23
	70	9.2	8.8	8.2	7.4	6.5	5.6	4.4	2.9	1.2		17
11	60	9.9	9.4	8.5	7.6	6.6	5.2	3.5	1.3			10
	70	10.0	9.6	8.8	8.0	7.1	6.0	4.7	3.1	1.3		21
	80	10.1	9.8	9.2	8.6	8.0	7.3	6.6	5.6	4.3	2.3	2

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D.B.H. o.b.	Total height	Diameter inside bark at height above ground of -- 5 feet	9 feet	17 feet	25 feet	33 feet	41 feet	49 feet	57 feet	65 feet	73 feet	Basis
Inches	Feet	Inches										Trees
12	60	10.8	10.2	9.2	8.2	7.0	5.5	3.7	1.3			11
	70	10.9	10.4	9.5	8.5	7.5	6.4	5.0	3.2	1.3		19
	80	11.0	10.6	9.9	9.3	8.7	8.0	7.2	6.2	4.8	2.7	5
13	60	11.6	10.8	9.8	8.7	7.4	5.8	3.8	1.3			5
	70	11.7	11.1	10.1	9.0	8.0	6.8	5.2	3.3	1.4		13
	80	11.8	11.3	10.6	9.9	9.3	8.6	7.7	6.7	5.3	3.0	5
14	60	12.4	11.5	10.4	9.1	7.8	6.0	3.9	1.4			1
	70	12.5	11.8	10.7	9.5	8.4	7.1	5.4	3.4	1.4		5
	80	12.6	12.0	11.2	10.5	9.8	9.1	8.2	7.1	5.6	3.3	2
15	60	13.2	12.1	10.9	9.6	8.1	6.2	4.0	1.4			1
	70	13.3	12.4	11.2	9.9	8.8	7.3	5.5	3.5	1.4		2
	80	13.4	12.7	11.8	11.1	10.4	9.6	8.6	7.4	5.9	3.5	1
												655

The table indicates the diameter inside bark at regular intervals above the ground. By means of this table it is possible to determine how many logs or bolts of different diameters can be cut under any utilization practice from trees of various sizes, and to scale the different parts of the tree in different units of volume.

April 1939

S. R. GEVORKIANTZ, Silviculturist

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No. 156

Employment Provided by Cutting and Processing Forest Products in the Lake States

Employment records and estimates collected by the Forest Survey in the Lake States indicate the following average rates of employment per unit of product:

Product	Unit of forest product	Man-days of employment per unit of forest product	
		Logging and hauling	Milling (primary phase)
Lumber	M ft.b.m.	1.5	1.8
Lath	M pieces	0.4	0.7
Shingles	M pieces	0.25	0.4
Veneer	M ft.b.m.	2.5	6.2
Wooden containers . .	M ft.b.m.	2.0	6.2
Distillation wood . .	Cord	1.0	0.9
Pulpwood	Cord	1.5	1.1
Excelsior wood	Cord	1.5	1.0
Hewed ties	Piece	0.1	-
Mine timbers	M ft.b.m.	2.0	-
Mine poles and lagging	M cu.ft.	10.0	-
Piling	M ft.b.m.	2.5	-
Poles	Piece	0.15	-
Cabin poles	M ft.b.m.	2.5	-
Posts	M pieces	25.0	-
Fuel wood	Cord	1.5	-

These figures do not purport to supply a standard with which to measure efficiency for any particular mill or operation. There is a wide range in labor required to produce different types of the same product, as, for example, between rough posts cut for farm use and commercial posts that are peeled and shipped considerable distances. However, the above table can be used to determine, in a rough way, how much employment will be provided by the harvesting of a given amount of timber.

Assistance in the preparation of this material was furnished by the personnel of Work Projects Administration, O.P. 665-71-3-69, Sponsor, University of Minnesota, and O.P. 01-2-71-126, Sponsor, Lake States Forest Experiment Station.

May 1940

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL, MINNESOTA

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Forests Give Extensive Employment

It is estimated that at least 153,000 men in the Lake States are dependent upon logging and forest-product industries for all or a substantial part of their income. This includes 51,000 men engaged in logging and transportation, 33,000 men working in sawmills, pulp mills, and other primary industries, and 69,000 in the secondary wood-using industries. It does not include employment in lumber yards, carpentry, or factory work where wood is used but is not a part of the finished product.

One acre of mature timber in the Lake States, when all merchantable products are utilized, gives employment to an average of 10 men for one week. An average acre of old-growth forest contains 9 thousand board feet of sawlogs and 15 cords of pulpwood, fuel and mine wood. At the average rate of $1\frac{1}{2}$ man-days for logging and hauling and 2 man-days for milling, the cutting of the 9 thousand feet of sawlogs means $31\frac{1}{2}$ man-days employment. At the average rate of $1\frac{1}{2}$ man-days per cord, the cutting of 15 cords of pulpwood, fuel and mine wood provides an additional $22\frac{1}{2}$ man-days for the acre, or in all, 54 man-days.

These computations are based upon present forest practice, which means clear-cutting. Under a selective cutting system, when not all merchantable trees are cut at one time, employment per single acre will be less, but cutting will be carried on over a larger acreage with the assurance that employment will be continuous.

May 1940

No. 157

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION

UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Top-Root Ratio and Size of Top Very Important in Fall-Planted Stock

The balance of planting stock as gauged by top-root ratio based on fresh ht of seedlings proved to be a very important factor, especially in overwinter tation survival on planting sites with little or no overhead cover on the atha National Forest.

In fall 1938 and spring 1939 a planting of jack and red pine was established n open sand-plain area near Cooks, Michigan. The site had no overhead cover the soil had a silt-plus-clay content of 8 percent for the first foot and 3 to rcent for the second foot. The previous cover had been red and white pine. ivals for the various lots of stock are given in the table below. Each survival re is based on four replications of 100 trees each. Measurements of stock at of planting are based on 30 trees of each lot. The rainfall for the growing on was fairly good, except for July when the total rainfall was only 0.90 inch. e were no abnormal temperatures and hence heat injury was not a factor in summer es.

ecies	Age class	Nursery1/	Length: Tops	Length: Roots	Stem diameter 64th inches	Total green weight	Top-root ratio by weight	First-year survival: Fall planted	First-year survival: Spring planted
			Inches	Inches		Grams		Percent	Percent
pine	1-0	Wyman	1.3	5.8	4.3	1.2	2.4	90.5	
	1-0	H. S.	3.7	8.2	6.0	3.1	3.0	84.2	
	1½-0	Wyman	3.1	8.5	6.7	2.4	4.2	94.2	
	2-0	H. S.	8.2	11.4	11.4	10.9	5.3	56.4	
	2-0	Hayward	6.8	11.2	8.0	7.2	4.9	93.5	
	1-1	Hayward	4.2	10.6	8.0	6.4	2.5	93.2	
	2-1	Hayward	7.3	10.4	10.5	11.0	2.6	81.8	
pine	2-0	Wyman	2.3	9.3	7.9	4.4	3.0	92.7	89.7
	2-0	H. S.	2.9	9.6	8.6	5.4	4.5	91.2	91.0
	3-0	H. S.	6.6	13.1	11.9	16.4	5.4	68.7	82.2
	2-1	Wyman	3.3	9.7	8.4	7.2	2.2	95.7	95.2
	2-1	H. S.	3.6	9.6	9.5	7.9	1.6	90.7	97.0
	2-2	Wyman	5.2	12.1	12.4	22.5	3.2	99.6	99.4
	2-2	H. S.	8.2	14.1	14.8	28.0	2.7	91.0	98.0

1/ yman Nursery, Manistique, Michigan, Hugo Sauer Nursery, Rhinelander, Wisconsin, an Hayward Nursery, Hayward, Wisconsin.

It will be noted that the 2-0 jack pine and 3-0 red pine of poorest balance lowest survival. The 2-0 jack pine from Hayward and 2-0 red pine from Hugo r show considerably better survival than the poorest balanced lot in each ies, but when the weight of top is computed and length of top is considered, ill be seen that this stock had much less top exposed to overwinter loss by cation, which was the principal cause of loss in fall planting. On the basis his experiment and on past field experience it is recommended that tall seedling k with poor top-root ratio should be reserved for spring planting.

No 158 May 1940

stance in the preparation of this material was furnished by the personnel of Projects Administration, O.P. 665-71-3-69, Sponsor, University of Minnesota, O.P. 01-2-71-136, Sponsor, Lake States Forest Experiment Station.

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 159

White Cedar for Deer Food

ing operations, when they occur in winter deer-concentration areas, are often a ce of considerable easily available browse for these animals, particularly where hern white cedar is cut. During critical periods for deer it is sometimes desir- to cut cedar to supplement the food supply. To determine how many deer such ations can support, it is necessary to know approximately how much browse differ- sized white cedar trees will provide. To determine this a large series of trees ing from 1/4 inch d.b.h. to 12 inches d.b.h. were cut and all the leafy parts ped and weighed. While it is appreciated that the quantity of foliage varies iderably with the density of the stand it is felt that the data obtained will an approximate figure that closely approaches the actual for average stands.

reas where deer concentrate there is usually a total absence of the trees in the , 1/2-, and 1-inch d.b.h. class, and the larger trees all have a distinct browse at least 7 feet above the ground. Inasmuch as these studies were made in an where deer had not influenced the stand, it was necessary to obtain a correction or for trees in a heavily browsed area. To approximate this, the weight of the age up to 7 feet above the ground was determined and recorded separately. These res are shown at the bottom of the table. To make the correction for trees cut eer-browsed areas the figure for total browse minus the figure up to 7 feet will the quantity remaining on the tree.

table below gives the figures obtained from this study:

D.b.h. (inches):	1/4	1/2	1	2	3	4	5	6	7	8	9	10	11	12
							(Pounds of browse)							
re tree	0.3	0.7	2.2	5.7	11.2	17.5	24.1	31.2	37.8	46.5	54.3	61.7	68.5	74.0
to 7 feet ove ground	0.3	0.7	2.0	4.0	4.5	4.1	3.5	2.8	2.1	1.5	1.2	0.7	0.5	0.4

enport in Michigan has determined that it takes 4½ pounds of white cedar a day as sole food to keep an average deer in good strength. This data applied to that n the above table will give a general idea of how many trees must be cut to take e of any known number of deer. In the case of logging operations we can estimate amount of cedar browse that will be made available and predetermine how many r can be carried by the operation. These studies have not taken into considera- n the quantities of browse made available from other trees, such as birch, balsam, le, etc., that may be cut by loggers. These are all important and help to supple- t the cedar and increase the carrying capacity of the operation.

SHALER E. ALDOUS

1940

istance in the preparation of this material was furnished by the personnel of k Projects Administration, O.P. 665-71-3-69, Sponsor, University of Minnesota, O.P. 01-2-71-126, Sponsor, Lake States Forest Experiment Station.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL, MINNESOTA

Thinned Stands Fill Up Rapidly

In the fall of 1929, the Station established a series of permanent lots to study the effect of various degrees of thinning on growth and roduction of merchantable wood in young jack pine. Thinnings were made n an overstocked stand of 20-year-old jack pine located on medium to good ite in the Chippewa National Forest. The smaller trees were the ones enerally removed from all stands.

Plot No. 29 was left unthinned.
" " 30 was thinned out to 89 percent of normal basal area.
" " 28 was thinned out to 77 percent of normal basal area.
" " 26 was thinned out to 62 percent of normal basal area.
" " 27 was thinned out to 40 percent of normal basal area.

Last fall, or 10 years since the establishment, the plots were remeasured. All plots showed very good response to thinning. The most striking was the growth in total basal area, or the total cross-sectional area of trees at breast height. As shown in the accompanying table, the lightly thinned plots have already surpassed the normal basal area, medium thinning almost reached normal, and the heavily thinned plot, growing the fastest, is approaching the goal rapidly by having more than doubled its residual basal area in 10 years.

Growth in Basal Area per Acre

Plot number	Basal area per acre		Percent of normal		The rate of growth per year
	After thinning	10 years later	After thinning	10 years later	
	Sq. ft.	Sq. ft.	Percent	Percent	Percent
29.....	100.8	138.8	109	112	3.8
30.....	80.3	128.6	89	106	6.0
28.....	67.6	121.6	77	103	8.0
26.....	53.6	114.2	62	98	11.3
27.....	36.1	92.7	40	78	15.7

May 1940

No. 160

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U. S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 161

Effectiveness of Soil Scarification in Promoting Jack Pine Reproduction

In developing management practices for jack pine, great stress has been laid on the necessity of scarifying the ground surface in order to get successful natural reproduction. Some recent jack pine cuttings on the Chippewa National Forest provide data which indicate once again how effective scarification can be.

Reproduction quadrats were established in a jack pine stand cut in the fall of 1937. The ground was scarified completely, but of course there were many small spots missed. When the reproduction quadrats were established, some fell on ground completely scarified and some on ground that had been missed altogether, and some on in-between conditions.

The relation between degree of scarification and number of seedlings is shown in the following table. The number per acre includes both 1938 and 1939 seedlings.

Percent scarified	Total quadrats	Number of seedlings per acre
0	44	45
10 and 20	42	405
30 and 40	42	1,285
50 and 60	23	2,260
70 and over	6	5,835

The advantage of as complete scarification as possible is very apparent.

May 1940

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 162

Effect of Liquid Fertilizers on Nursery Stock

ıe present policy in fertilization of nurseries in the Lake States calls for pplication of compost or peat with commercial fertilizers previous to seeding, ıd in amounts adequate to take care of nutrient needs of the seedlings for sev- ral years. Occasionally the initial treatment is not adequate and the nursery- ın applies liquid commercial fertilizers through the overhead sprinkling system : with a special sprayer.

ı experiment installed at Hugo Sauer Nursery, Rhinelander, Wisconsin, indicated ıat liquid fertilizers improve not only color, vigor, and needle length, but ıso field survival of the stock.

ıe nursery test consisted of replicated plots of 2-0 red pine growing at a density : 80 seedlings per square foot, which were treated with liquid fertilizers on July ı of the second growing season and field planted on October 18, 1937. Field tests ɔnsisted of four replications of 200 trees in each treatment, except the untreat- d plots which had eight replications.

ıe 15-30-15 nitrophoska was applied at the rate of 10 quarts of solution per 50 quare feet of bed. The liquid humate consisted of nitrophoska added to a barrel ıe-third full of hardwood-hemlock duff and filled with water. The solution was tirred and applied at the rate of 10 quarts of solution per 50 square feet of bed. esults are given below:

Nursery treatment	Classification of nursery stock 1/			Green weight of average 2-0 seedling	Field Survival	
	Plantable	Good	Excellent		First year	Second year
	Percent	Percent	Percent	Grams		
one.....	64	14	4	1.55	71.6	54.7
00 pounds nitrophoska.....	76	16	10	1.79	72.8	62.2
00 pounds nitrophoska.....	94	48	24	2.73	80.4	58.9
00 pounds nitrophoska.....	94	54	36	3.14	72.4	57.7
00 pounds liquid humate...	68	6	6	1.77	70.9	57.1
00 pounds liquid humate...	86	30	18	2.45	75.6	65.1
00 pounds liquid humate...	92	40	22	2.37	77.7	62.3

/In classifying nursery stock, trees 4/64 inch caliper and over are considered lantable; those 5/64 inch and over are good;those 6/64 inch and over are excellent. ll stock had fairly good balance.

ıe table shows a higher percent of plantable trees for the fertilized trees and nall but consistently higher increase in field survival. Considering both nursery roduction and field survival, it appears that a treatment of around 400 pounds of alanced liquid fertilizer per acre is the most effective treatment in this nursery.

ıy 1940

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL, MINNESOTA

Ten Million Dollars Worth of Lumber Produced in Wisconsin, 1938

Lumber produced in Wisconsin in 1938, although 11 percent less in volume than 1937 and only about one-ninth of the volume produced in the peak year 1899, was worth about $10,000,000 according to figures collected by the U. S. Forest Service and U. S. Census. The 1938 production of 486 active mills reporting was 371,770 thousand feet, board measure. The Lake States Forest Experiment Station estimates that some 800 small portable mills produced an additional 14,500 thousand board feet.

Production of the larger mills is shown by species and the average value of the lumber, logs, and stumpage sold is given in the following table:

Species	1938 production		Value		
	Volume	Percent	Lumber per thousand board feet	Logs used for lumber per thousand feet	Standing timber per thousand feet
	M bd.ft.		Dollars	Dollars	Dollars
Softwoods					
Pine	39,137	10.5	29.18	19.74	7.41
Spruce	1,004	0.3	25.28	19.93	1/
Balsam	201	0.1	1/	1/	1/
Tamarack	614	0.1	21.95	16.71	1/
Hemlock	118,939	32.0	22.52	13.99	1/
Cedar	1,985	0.5	1/	1/	1/
All softwoods	161,880	43.5	24.06	15.68	6.94
Hardwoods					
Maple	75,073	20.2	30.14	22.20	6.38
Birch	49,507	13.3	35.49	21.97	7.65
Beech	836	0.2	1/	1/	1/
Basswood	23,271	6.3	35.28	20.34	10.02
Elm	16,710	4.5	27.78	18.50	1/
Oak	30,377	8.2	26.00	19.15	4.86
Aspen	10,325	2.8	18.94	1/	2.60
Miscellaneous	3,703	1.0	26.07	19.48	6.50
All hardwoods	209,890	56.5	30.55	21.19	7.08
All species	371,770	100.0	27.72	19.87	7.03

1/ Insufficient data on these species to determine the true value but they have been included in the averages.

At an average value of $27.72 per thousand, the total production would be worth $10,305,464.

May 1940

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL, MINNESOTA

Relationship of Temperature to Dispersal of Jack Pine Seeds

Mature jack pine cones remain attached to the trees and generally do not open for many years. In this manner a large supply of seeds--as many as two million per acre--accumulate on the trees. The only practical way that has been found to cause the seeds to disseminate after logging jack pine timber is to lop and scatter the cone-bearing branches close to the surface of the ground where the heat from the sun dries the cones sufficiently for them to open. In order to assure prompt and reasonably complete opening, the cones must be placed on or within a few inches of the ground. At a height of 1 foot the opening is slow and uncertain and at an elevation of 4 or 5 feet the cones are likely to stay closed indefinitely. The following table shows the temperature relationships that account for this behavior.

Average maximum temperature for 14-day period in late July and early August
Superior National Forest

Position	Temperature (degrees Fahrenheit)
Ground surface...	127.5
4½ inches.....	94.0
9 inches.....	91.8
18 inches.....	91.0
36 inches.....	89.5

Slash-disposal regulations for national-forest timber sales have been modified to meet this requirement for dispersal of jack pine seeds.

No. 1164 May 1940

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL, MINNESOTA

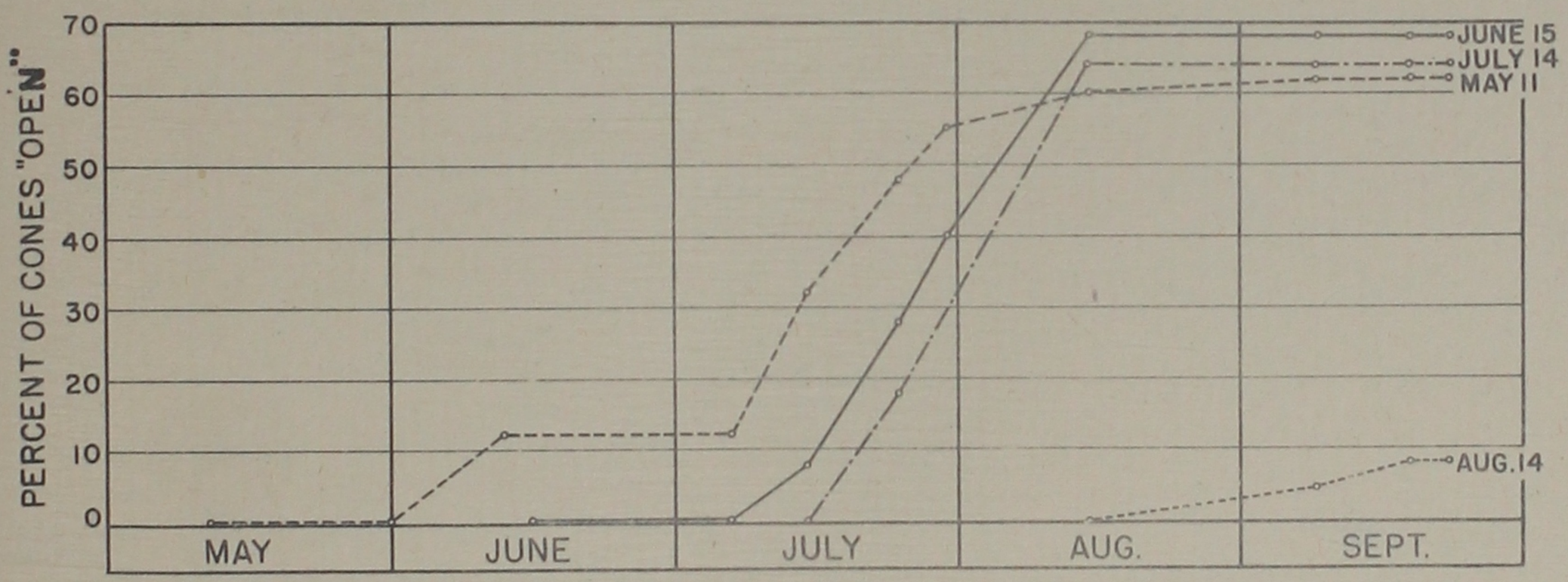
Jack Pine Cones in Slash Open in Midsummer

Since it has been found that jack pine seeds which fall to the ground during the period from early November to early June have a much better chance of germinating and becoming established than seeds that fall during July, August, September, and October (see Technical Note No. 168), a test was made to learn if the time of cutting and scattering the cone-bearing slash influenced the time when the cones opened.

Freshly cut cone-bearing branches were placed at five different distances above the ground at five different dates, as shown in the accompanying table. Whenever a cone opened sufficiently to allow most of its seeds to escape, this was recorded. The percentage of the cones which had opened by September 22 is shown in the table. Each percent value is based upon 40 cones.

Height above ground (inches)	Percent of cones open wide enough for most of seeds to escape on September 22				
	Date of cutting				
	May 11	June 15	July 14	August 14	September 8
36	0	0	0	0	0
18	0	5	20	0	0
9	10	10	8	0	0
4½	20	20	35	0	0
0	62	68	64	8	0

The time when the cones on the ground surface opened is shown in the diagram. Cones at the other levels opened at practically the same times but in smaller percentages.



It is possible that some opening might occur during May if the season were very dry but it appears from this test that July and early August is the only period when jack pine cones are certain to open in large numbers.

No. 165 May 1940

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL, MINNESOTA

Light Cuttings in Hardwoods Show High Quality Increment

The advantages of light cuttings in increasing quality growth of the esidual stand were brought out by the analysis of three of the experimental uttings (light, moderate, and heavy) that have been in effect for ten years t the Upper Peninsula Experimental Forest. In the heavy cutting the growth as mostly on small saplings, in the moderate cutting it was distributed ver quite a range of diameters, and in the light cutting growth was con-entrated on large trees.

The extensive mill-scale studies carried on a number of years ago in onnection with selective logging established a definite relationship between iameters of trees and value of the lumber per M feet cut from them. By pplying these values to the increment obtained in the three types of cutting, he growth per acre per year was computed to be worth $4.25 for the light utting, $2.67 for the moderate cutting, and $0.68 for the heavy cutting. hese differences are further accentuated by the fact that the value given or the light cutting could be realized immediately if it were necessary to ut it, whereas that from the heavy cutting is scarcely realizable at all, ince the stand is too poorly stocked to warrant returning for a second cut ithin a reasonable period. Despite the fact that the mill-scale values ay be somewhat changed today, the relationships remain the same, and it is erfectly clear that the light cutting has given much the best results in uality growth. In order to gain the advantage of such quality growth the trees eft should be relatively sound and free of defect.

o. 166 May 1940

ssistance in the preparation of this material was furnished by the per-onnel of Work Projects Administration, O.P. 665-71-3-69, Sponsor, niversity of Minnesota, and O.P. 01-2-71-126, Sponsor, Lake States Forest xperiment Station.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 167

Do Young Second-Growth Northern Hardwoods Need Care?

The success of stand improvement work in young stands of conifers has been so obvious that lately efforts have been made to extend this silvicultural practice to young stands of northern hardwoods. Unfortunately, there has existed almost no experimental work which would indicate what results might be expected. However, the results of the 5-year remeasurements of several types and degrees of cultural work in 10 - to 20 - year-old northern hardwoods at the Upper Peninsula Experimental Forest have recently become available and it is possible to see what this type of work may be expected to accomplish.

Two main lines of attack were tried. One was to remove the scattered "wolf" trees, remnants of the original stand, either by cutting or girdling. This appears to be a desirable operation.

The second treatment was an attempt to release the better individuals in the young reproduction. Several methods were tried, but the conclusions reached were similar for all.

When sugar maple and yellow birch, the two most important species in this locality, were released from competition within a radius of more than 3 feet, they responded by putting out many new branches along the entire trunk, thus producing wider and denser crowns at the expense of height growth.

Exposed trees were often sunscalded along the west and south side of the bole.

Small red maples when cut off sprouted profusely and in the heavier degrees of release the stocking of this species actually increased after cutting operations.

Inferior species such as willow, aspen, and fire cherry, which are choked out in the well-stocked stand, were encouraged by release cutting.

Individual release of crop trees has been suggested as a method to apply to young hardwood stands. Work at the Upper Peninsula Station indicates that the stand should be older than 10 or 20 years to permit the selection of crop trees, since the future of such young trees is most difficult to predict.

All of the work to date indicates that cultural work in young second-growth hardwoods (except for the removal of "wolf" trees) is of doubtful desirability and that such stands should be permitted to develop in dense, fully stocked condition until the trees are large enough to be merchantable for cordwood. Light selection cuttings would then tend to develop the all-age selection forest.

May 1940

Forester JOHN R. NEETZEL

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 168

Effect of Season on Germination and Early Survival

In developing methods of cutting jack pine to insure natural regeneration of the stand, a test was made to discover what is the most favorable time of year for the seed to fall to the ground.

Small spots were scalped and then lightly covered with jack pine brush to simulate as closely as possible the conditions resulting from cutting jack pine and preparing the ground surface in accord with approved methods for these operations.

To avoid unduly attracting birds and rodents to freshly dug ground, a period of seven to ten days was allowed to elapse before the seed was scattered on the spots.

Eight different periods were chosen for the sowings which were arranged in the form of a Latin square, 100 seeds being sown in each of the 64 spots.

The chart shows the percent of live seedlings at the end of one year. The spots sown in May, June, and July were counted in the following spring; those sown in August, September, October, November, and April were counted the following fall.

Time sown	Percent of live seedlings
May	28
June	20
July	14
August	6
September	1
October	1
November	25
April	19

The disadvantages of August, September, and October are obvious. The other months are about equal except for July, which is intermediate. Differences are statistically significant.

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 169

Fertilized Nursery Stock Shows Increased Nursery Production and Higher Field Survival

Considerable controversy has occurred over the question of what effect fertilization in the nursery has on field survival. Some planters believe in the theory that since planting sites for species like jack pine are low in fertility, the nutrient level in the nursery should be held down to "adapt" the stock to the prospective planting site. Others believe in maintaining an abundant supply of nutrients.

To test these theories under actual field conditions, a comprehensive series of experiments was started at Hugo Sauer Nursery, Rhinelander, Wisconsin. One of these experiments dealt with 1-0 jack pine and the nursery and field results are listed below. The field planting was done in furrows. The soil was a fine sand containing 14.3 percent of silt and clay in the top 18 inches of soil. The site had a light cover of aspen 2 to 3 inches in diameter. Four replications of 200 trees were used for each treatment in the field test. The nursery soil previous to fertilization showed the following analysis: silt + clay, 12 percent; total nitrogen, 0.081 percent; base exchange capacity, 4.42 milliequivalents per 100 grams; available phosphorus, 77 parts per million; available potash, 115 parts per million. The fertilizers were spaded into the top 6 inches of soil a few days before sowing the seed. Seedling stand was 50 per square foot.

Nursery treatment per acre	Classification of nursery stock[2]			Second-year field survival
	Plantable	Good	Excellent	(thrifty trees)
	Percent	Percent	Percent	
treatment.....	60	12	7	69.6
ons compost[1].....	92	45	22	73.0
tons peat (ovendry basis).....	87	30	10	77.3
tons dry peat + 400 pounds 20-percent monium sulphate + 600 pounds 20-rcent superphosphate + 160 pounds 50-rcent potash.....	100	67	47	77.0
pounds 20-percent ammonium sulphate 600 pounds 20-percent superphosphate 160 pounds 50-percent potash.....	95	22	12	70.7

1/ Compost consisted of hardwood-hemlock duff, acid peat from spruce swamps, and complete N, P, K commercial fertilizers. Applied on ovendry-weight basis.
2/ In rating the nursery stock, plantable trees have stem caliper of 4/64 inch or greater; good, 5/64 inch caliper or greater; excellent, 6/64 inch caliper or greater. All the stock had good balance.

It will be noted that all of the fertilizer treatments produced a higher field survival and also higher percent of plantable stock than the untreated beds. Culling is an expensive operation, especially where cull percent runs up to 30 or 40 percent. On the basis of the above data an investment ranging from $30 to $80 per acre for fertilizers and labor resulted in an increased value of stock amounting to $150 per acre for each 10 percent increase of plantable stock, using an assigned value of $1 per M for 1-0 jack pine stock.

May 1940

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

When to Pick Pine Cones

Reforestation at the present rate of about 150,000 acres a year in the three Lake States requires yearly collection of 10,000 to 15,000 bushels of pine cones. To get the highest yield of good-quality seed, the cones must be gathered at just the right time. If they are collected too early, much of the seed is not viable; if they are collected too late, much of the best seed has been shed. Therefore, some reliable, easily applied method of determining cone ripeness is needed.

Through studies carried on in lower Michigan during 1938 and 1939, the Lake States Forest Experiment Station has developed such a method. Specific gravity has been found to provide a reliable test of cone ripeness for red pine and white pine, although not for jack pine. Cone color, also, has proved to be a good index of ripeness, although it is much more difficult to define and measure. The following table gives criteria of ripeness for fresh cones of the three Lake States pines:

Species	Specific gravity	Cone color
Red pine	0.85	Deep purple, with brown on scale tips.
White pine	0.92	Yellowish green, with brown on scale tips.
Jack pine	No test	Half or more of cone surface brown.

The specific-gravity test should be applied as follows: (1) Collect at least 5 cones from a tree. (2) Drop the freshly picked cones into the test liquid, kerosene for red pine and linseed oil for white pine. (3) Note how many of the cones float. If a majority float, it is safe to collect from that tree. Care must be taken to test freshly picked cones only; results will be misleading if the cones have had time to dry out even a little.

Since individual trees vary considerably in cone ripeness at a given time, it is best to test several trees separately; however, in a locality where several trees are found to have ripe cones, it is safe to collect from any trees.

The period during which cone collections can best be made usually lasts 20 to 30 days.

No. 170 August 1940

Assistance in the preparation of this material was furnished by the personnel of Work Projects Administration, O.P. 665-71-3-69, Sponsor, University of Minnesota, and O.P. 101-2-71-28, Sponsor, Lake States Forest Experiment Station.

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 171

How to Keep Christmas Trees Fresh

Water has been found the most effective means of retarding the falling of needles from black spruce Christmas trees. In the Lake States the two principal species of evergreens used for Christmas trees are balsam fir and black spruce. Balsam fir retains its needles for a long time, but black spruce, which is a highly desirable tree because of its compact, symmetrical form and dense foliage, sheds very rapidly.

Several methods have been suggested to prevent falling of needles from Christmas trees, including (1) standing the base of the tree in water or (2) in a solution of citric acid, malic acid, and calcium carbonate, and (3) covering the needles with a coating of wax to retard drying. In order to learn whether any of these methods assisted materially in preventing the needles from falling, Christmas trees treated in these ways were compared with trees that received no treatment.

It was found that standing the bases of black spruce Christmas trees in plain water was the best method. The water not only caused the needles to remain on the trees longer, but also kept the foliage greener and more healthy looking. Freshly cut trees and trees stored in a frozen condition from 1 to 5 weeks remained in reasonably good condition for 3 weeks when set in water in a heated room. "Dry" trees lost practically all of their needles in the same period, and chemically treated trees were intermediate in behavior. These tests were based upon 36 trees carefully selected for uniformity. In another, somewhat similar test using smaller samples, waxed trees were found to be inferior to watered and chemically treated trees.

In order to enable a tree to absorb water freely, it is suggested to users that they make a fresh, clean cut at the base of the stem before standing the tree in water.

December 1940

Assistance in the preparation of this material was furnished by the personnel of Work Projects Administration, O.P. 665-71-3-69, Sponsor, University of Minnesota, and O.P. 01-2-71-126, Sponsor, Lake States Forest Experiment Station.

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 172

The Animal Factor in Natural Reproduction of Jack Pine

The quantity of coniferous seed eaten by small rodents and birds has been the subject of study by the Station's biologist. Because the animals involved are small, elusive, and mostly nocturnal, direct observation of their seed-eating habits is almost impossible. Several indirect approaches have been attempted and the results permit a few generalized statements to be made.

In order to determine what species do eat coniferous seed, part of an area with cone-bearing jack pine slash was trapped throughout the summer. The contents of the stomachs of the animals caught on the area were analyzed. In all, 45 stomachs were examined, distributed as follows:

White-footed mice	22	Chipping sparrows	8
Red-backed mice	9	Juncos	2
Western chipmunks	1	Jumping mice	3

Jack pine seeds were found in the stomachs of only two species--the chipping sparrows and the white-footed mice. Thirty-eight percent of the chipping sparrows and 45 percent of the white-footed mice had been feeding on these seeds. The number of seeds eaten in each case was usually small, although two of the mice had consumed 60 and 20 seeds respectively. In addition to these findings, jack pine cones that had been reduced to middens by red squirrels were found on the area.

In order to determine the amount of seed eaten, counted quantities of jack pine seeds were placed in small low-sided screen baskets. These were exposed in the woods for 10 days. At the end of that time 82 percent of the seeds were missing. The presence of empty hulls in some cases was evidence of the work of small rodents. However, some losses were encountered on the check plots which could only be attributed to the activity of insects as it was impossible for birds or rodents to get access to them. In contrast to this, planted jack pine seeds unprotected except by soil coverage suffered only a 39-percent loss and planted seeds that were protected from birds and rodents suffered only an 18-percent loss. Part of the latter-termed losses were in reality germination failures and possibly some insect damage. White pine seeds showed 11 percent better germination on protected plots.

In another test jack pine cones were marked and set on the ground to open. After being exposed for 15 days a count of the remaining seeds was made and showed approximately a 15-percent loss due to rodents or birds.

The conclusions which can safely be drawn from these studies are: (1) Small rodents and birds do have a part in restricting natural regeneration of conifers; (2) in the case of jack pine, animal losses can be reduced if the soil has been suitably prepared for the seeds when they fall; and (3) indications are that white-footed mice and chipping sparrows are the most important offenders.

January 1941

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 173

Storage of Red Pine Seed

Heavy crops of red pine seed usually occur only at intervals of from 3 to 5 years; therefore, considerable quantities must be collected and stored for use in those years when there is no crop.

In order that the viability of the seed may be maintained during the storage period, the conditions of storage are important.

In 1930, the Station put into storage some red pine seed of the 1928 crop. At the time of storing, the moisture content of a portion of the seed was reduced from its original 5.9 percent to 4.7 percent and the moisture content of the remainder was increased to 6.5 percent. Samples of seed of both moisture contents were stored in four different places. Some of the seed was taken out in 1936 and germinated. In 1940, 10 years after it was first put into storage, the remainder was tested for germination. The following table shows the results:

Germination of Red Pine Seed after Storage at Different Temperature and Moisture Conditions

Temperature condition	Moisture content at beginning of storage, 1930	Total germination percent 1940	Total germination percent 1936
	Percent		
32-39° F.--Cold Room	4.7	97.5	95.4
	6.5	97.0	94.8
41-50° F.--Cold Room	4.7	93.2	90.8
	6.5	57.4	90.6
32-68° F.--Underground Cellar	4.7	58.9	94.4
	6.5	33.7	89.6
0-100° F.--Unheated Attic	4.7	46.2	66.8
	6.5	26.4	56.8

These results indicate that red pine seed can safely be stored in tightly sealed containers at temperatures of 32° to 40° F., with moisture contents of not more than 6.5 percent, for at least 10 years. Slightly higher temperatures--up to 50° F.--may be used safely if the original moisture content of the seed is reduced to less than 5 percent.

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MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 174

Blowouts in the Sandhills Reclaimed by Trees

In the sandhills area of central North Dakota, wind erosion removes 4 to 7 feet of soil over areas ranging from 1 to 80 acres in size. These are known as blowouts. In these areas seedlings of rye, native and introduced grasses, and forage crops usually fail because the stand is ruined in the seedling stage by the cutting action of the wind-borne sand.

However, the Station has found that these blowouts could be successfully stabilized by mass planting of large, sturdy cottonwood wildlings from 1/4 to 1/2 inch in diameter at the ground line.

During the first few years a lister furrow was plowed between each tree row in order to reduce somewhat the velocity of sand blast. No cultivation was necessary because the sand had sufficient velocity to cut off practically all the volunteer vegetation. The cottonwood wildlings made fairly good growth in spite of considerable removal of bark on the windward side (northwest in this case). Other species like Chinese elm, chokecherry, burr oak, and Russian olive failed because of sand blasting, slow growth, or low soil fertility.

It is believed, on the basis of this experience, that sandy areas which have suffered almost complete loss of topsoil and consequently their value for agriculture can be most cheaply reclaimed by fencing and mass planting of cottonwood for wood-lot and stock-shelter use. This applies especially to areas which have deep sand substrates and a permanent water table within 15 feet of the surface because such sites are very favorable to cottonwood.

Assistance in the preparation of this material was furnished by the personnel of Work Projects Administration, O.P. 165-1-71-124, Sponsor, University of Minnesota, and O.P. 101-2-71-28, Sponsor, Lake States Forest Experiment Station.

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
No. 176
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Testing Cone Ripeness

A simple method for testing the ripeness of red and white pine cones by means of specific gravity has been described in Technical Note 170. As an aid to the practical application of this test a simple field kit has been devised by means of which the progress of cone ripening can be followed and reasonably accurate plans for collection made in advance.

The kit consists of a wooden box divided into 4 compartments and topped with a hinged cover. In each compartment is placed a covered container (quart fruit jars, 1/2- or 1-gallon paint cans, or the like) and an ice pick or ice-cube tongs for removing cones after testing. The containers are filled from left to right with (1) water, (2) linseed oil, (3) a mixture composed of equal parts of linseed oil and kerosene, and (4) kerosene. The kit is used as follows: First, 5 or more cones are collected from a tree and dropped in container 1. Second, if the cones sink, no further test is necessary; if they float, then they are dropped in container 2, and so on. White pine cones which float in container 2 are ripe and no further test is necessary. Red pine cones are not fully ripe until they float in container 4, but reasonably good quality seed can be recovered from cones which float in container 3, and where a large-scale collection program is anticipated, about 10 days can be added to the collection season by beginning at the time the cones float in the linseed oil-kerosene mixture.

The following table, which shows the average number of days in which cones will float in a given liquid after they first float in the next heaviest liquid should serve as a guide for making additional tests on planning the beginning of the collection operation:

Species	Average time at which cones will float in designated liquid							
	Water		Linseed oil		Equal parts of linseed oil and kerosene		Kerosene	
	1/ Days	2/ Dates	Days	Dates	Days	Dates	Days	Dates
Red pine	0	8/10-20	18	9/1-10	6	9/10-15	10	9/17-23
White pine	0	7/25-8/5	32	8/27-9/6	9	9/6-12	6	9/10-15

1/ Number of days cones will begin to float in designated liquid after they first float in next heaviest liquid (to the left in the kit).

2/ These are dates between which floating can be expected to begin in northeastern quarter of Lower Michigan. Other localities will doubtless have somewhat different dates.

January 1941

Assistance in the preparation of this material was furnished by the personnel of Work Projects Administration , O.P. 165-1-71-124, Sponsor, University of Minnesota, and O.P. 101-2-71-28, Sponsor, Lake States Forest Experiment Station.

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 177

Effect of Temperature on Germination

In conducting routine germination tests in the Laboratory, all seeds are usually germinated under the same temperature conditions, although the conditions may vary from one testing laboratory to another. The temperature adopted by the Lake States Forest Experiment Station as standard is a range from 68° F. at night to 86° F. during the daytime. This approximates summer temperatures in this region.

However, in spite of long after-ripening treatments, some species failed to germinate under these conditions. Cutting tests of the ungerminated seed have showed it to be sound.

For many of these species it is believed the temperature of the germination room may be the limiting factor. In order to test this, a separate germination room was constructed with a temperature range from 50° to 77° F. This simulates the long period during the spring which is characterized by relatively cool nights and warm days. In addition, germination was attempted at two different constant temperatures -- 41° F. and 50° F.

Conclusive tests thus far have been completed on two species under these four temperature conditions. The results are shown in the following table:

Species	Temperatures			
	41° F.	50° F.	50-77° F.	68-86° F.
	Germination percent			
Boxelder (Acer negundo)	8.0	7.0	66.8	12.2
Wild plum (Prunus americana)	---	86.0	26.0	13.0

From tests on these two species it is quite apparent that temperature is an important factor in the germination process and that the optimum temperature for germination may be expected to vary markedly from one species to another.

Tests of other species which are normally difficult to germinate are now being conducted.

January 1941.

Assistance in the preparation of this material was furnished by the personnel of Work Projects Administration, O.P. 165-1-71-124, Sponsor, University of Minnesota, and O.P. 101-2-71-28, Sponsor, Lake States Forest Experiment Station.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Production of Lumber, Lath, and Shingles in Minnesota -- 1940 1/

The preliminary estimates of lumber production in Minnesota indicate an increase of 32.6 percent over the 1939 production as reported by the census.

These estimates are based on material obtained from the sawmill operators as a part of the lumber census conducted by the Forest Service in cooperation with the United States Census. All estimates are subject to correction, with the final report to be published by the Bureau of the Census.

In 1940, 399 active mills producing 50,000 feet or more annually sawed 147,424,000 feet of lumber and sawed ties. In addition, these mills produced 7,887,000 pieces of lath and 1,880 squares of shingles during the year. The production by species is shown in the following table:

Lumber production by species, 1940 (for mills cutting 50,000 feet or more)

Species	Volume	Percent
	M board feet	
Pine 1/	79,924	54.2
Spruce	3,394	2.3
Balsam fir	2,724	1.9
Tamarack	995	0.7
Cedar	5,478	3.7
Total softwoods	92,515	62.8
Maple	392	0.2
Birch	5,303	3.6
Basswood	3,414	2.3
Elm	4,533	3.1
Oak	8,827	6.0
Aspen	31,290	21.2
Miscellaneous hardwoods	1,150	0.8
Total hardwoods	54,909	37.2
All species	147,424	100.0

1/ Includes white, red, and jack pine.

In addition to this cut there is estimated to be 739 mills, sawing less than 50,000 feet annually which produced 13,751 M feet of lumber.

1/ Tabulated by Jack A. Diemer, Special Agent, Bureau of the Census and Assistant Forest Economist, Lake States Forest Experiment Station, University Farm, St. Paul, Minnesota.

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL, MINNESOTA

Production of Lumber, Lath, and Shingles in Wisconsin -- 1940[1/]

The preliminary estimates of lumber production in Wisconsin indicate an increase of 27.7 percent over the 1939 production as reported by the census.

These estimates are based on material obtained from the sawmill operators as a part of the lumber census conducted by the Forest Service in cooperation with the United States Census. All estimates are subject to correction, with the final report to be published by the Bureau of the Census.

In 1940, 473 active mills producing 50,000 feet or more annually sawed 430,109,000 feet of lumber and sawed ties. In addition, these mills produced 11,366,000 pieces of lath and 35,180 squares of shingles during the year. The production by species is shown in the following table:

Lumber production by species, 1940 (for mills cutting 50,000 feet or more)

Species	Volume	Percent
	M bd. ft.	
Pine[1/]	42,672	9.9
Spruce	869	0.2
Balsam fir	364	0.1
Tamarack	772	0.2
Hemlock	136,517	31.8
Cedar	9,190	2.1
Total softwoods	190,384	44.3
Maple	75,144	17.5
Birch	46,868	10.9
Basswood	24,720	5.7
Elm	18,940	4.4
Oak	57,821	13.4
Aspen	11,469	2.7
Miscellaneous hardwoods	4,763	1.1
Total hardwoods	239,725	55.7
All species	430,109	100.0

1/Includes white, red, and jack pine.

In addition to this cut there is estimated to be 956 mills, sawing less than 50,000 feet annually which produced 23,927,000 feet of lumber.

1/Tabulated by Jack A. Diemer, Special Agent, Bureau of the Census and Assistant Forest Economist, Lake States Forest Experiment Station, University Farm, St. Paul, Minnesota.

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MAINTAINED BY THE UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Production of Lumber, Lath, and Shingles in Michigan -- 1940 1/

The preliminary estimates of lumber production in Michigan indicate an increase of 26.9 percent over the 1939 production as reported by the census.

These estimates are based on material obtained from the sawmill operators as a part of the lumber census conducted by the Forest Service in cooperation with the United States Census. All estimates are subject to correction, with the final report to be published by the Bureau of the Census.

In 1940, 400 active mills producing 50,000 feet or more annually sawed 422,708,000 feet of lumber and sawed ties. In addition, these mills produced 5,536,000 pieces of lath and 13,321 squares of shingles during the year. The production by species is shown in the following table:

Lumber production by species, 1940 (for mills cutting 50,000 feet or more)

Species	Volume	Percent
	M board feet	
Pine 1/	25,009	5.9
Spruce	2,675	0.6
Balsam fir	610	0.2
Tamarack	387	0.1
Hemlock	107,021	25.3
Cedar	1,368	0.3
Total softwoods	137,070	32.4
Maple	155,237	36.7
Birch	45,993	10.9
Basswood	19,974	4.7
Elm	23,726	5.6
Beech	9,340	2.2
Oak	18,114	4.3
Aspen	5,447	1.3
Miscellaneous hardwoods	7,807	1.9
Total hardwoods	285,638	67.6
All species	422,708	100.0

1/ Includes white, red, and jack pine.

In addition to this cut there is estimated to be 647 mills, sawing less than 50,000 feet annually which produced 13,870,000 feet of lumber.

1/ Tabulated by Jack A. Diemer, Special Agent, Bureau of the Census and Assistant Forest Economist, Lake States Forest Experiment Station, University Farm, St. Paul, Minnesota.

INTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

LAKE STATES FOREST EXPERIMENT STATION*
University Farm, St. Paul, Minnesota

Beginning with No. 181, the technical notes "for the duration" will be devoted to problems bearing on our WAR PROGRAM. They will include information on timber production and requirements, labor-saving techniques, opening up new sources of wood supply, and extending the use of wood.

Short Cuts in Scaling

I. Measuring sample truck loads.

At present, scaling of 8-foot aspen and jack pine bolts is often done on loaded trucks. An analysis of 220 truckloads showed that in order to estimate within 3 percent it is sufficient to scale only a certain proportion of the total loads involved.

The table below indicates the proportion of loads that need to be scaled to arrive at an estimate having an error not greater than 3 percent. The table gives this information both for "small" bolts ranging in size from 6.0 to 8.9 inches in diameter at the small end, inside bark, and for "large" bolts, 9 inches or larger in diameter at the small end.

Truckloads in the operation		Truckloads to scale
Large bolts	Small bolts	Proportion
Number	Number	
25	10	every 2nd load
50	25	" 3rd "
100	50	" 5th "
200	100	" 10th "
500	250	" 20th "
750	350	" 30th "
1000	600	" 50th "
2500	1000	" 100th "

March 1942

* Maintained by the United States Department of Agriculture, St. Paul, Minnesota, in cooperation with the University of Minnesota.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Beginning with No. 181, the technical notes "for the duration" will be devoted to problems bearing on our WAR PROGRAM. They will include information on timber production and requirements, labor-saving techniques, opening up new sources of wood supply, and extending the use of wood.

Technical Note No. 182

Short Cuts in Scaling

II. Using stacked dimensions to obtain board-foot volume.

To obtain board-foot measure directly from stacked 8-foot bolts, a conversion table can be used. To determine the board-foot volume of a load or pile of aspen or jack pine cordwood, all that is necessary is to measure the length and height of the pile, count the number of sticks per standard cord, and then find in the table the corresponding board-foot volume per cord. The table shows the relation between cordwood volume and board feet by the Scribner rule.

Number of bolts per cord	Bd. Ft. per cord	Number of bolts per cord	Bd. Ft. per cord
8	487	24	334
9	474	26	320
10	463	28	306
12	440	30	293
14	421	32	281
16	412	34	268
18	384	36	257
20	366	38	245
22	350	40	235

A still further simplification is possible for quick computations if the bolts have been sorted into small and large sizes. "Small" bolts, from 6.0 to 8.9 inches in diameter at the small end inside bark, average 280 board feet (Scribner Dec. C) per standard cord, and "large" bolts, 9 inches or over in diameter, average 380 board feet per cord. It has been found that the woods run, or unsorted bolts, average 303 board feet per cord. Eventually these converting factors may lead to selling box-bolt stumpage by the cord.

All figures indicate gross scale. Deductions for defect must be applied when needed.

March 1942 S. R. GEVORKIANTZ, Forester

INTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 183

Beginning with No. 181, the Technical Notes "for the duration" will be devoted to problems bearing on our WAR PROGRAM. They will include information on timber production and requirements, labor-saving techniques, opening up new sources of wood supply, and extending the use of wood.

Short Cuts in Scaling

III. Measuring sample logs.

The table below shows the proportion of logs which must be scaled as a sample to come within certain limits of error for different-sized logging jobs.

By counting all logs and scaling only a given proportion, as shown in the table, the cost and time of scaling work, both in the field and in the office, will be greatly reduced.

When there are	Scaling every	6-foot long may be in error Percent	12, 14, and 16-foot long within Percent
500,000 logs	200th log	2.3	1.8
500,000 "	100th "	1.6	1.3
500,000 "	50th "	1.1	0.9
100,000 logs	50th log	2.5	2.0
100,000 "	30th "	1.9	1.5
50,000 logs	30th log	2.7	2.2
50,000 "	20th "	2.2	1.7
25,000 logs	20th log	3.1	2.5
25,000 "	10th "	2.1	1.7
10,000 logs	10th log	3.4	2.7
10,000 "	5th "	2.3	1.8
5,000 logs	10th log	4.8	3.8
5,000 "	5th "	3.2	2.5
5,000 "	3rd "	2.3	1.8
1,000 logs	5th log	7.2	5.7
1,000 "	3rd "	5.1	4.0
1,000 "	2nd "	3.6	2.8

March 1942

TAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 184

Beginning with No. 181, the technical notes "for the duration" will be devoted to problems bearing on our WAR PROGRAM. They will include information on timber production and requirements, labor-saving techniques, opening up new sources of wood supply, and extending the use of wood.

Volume of Fuel Wood in Tree Tops

With the growing importance of wood as fuel, it becomes desirable to determine just how much cordwood can be salvaged in saw timber operations. On the basis of a large number of careful measurements, the cordwood volume in hardwood tree tops per thousand board feet of lumber has been obtained. The portion of the stem above the last saw log and all branches that could be cut into 16-inch stovewood were included in this computation.

Total height of tree	Merchantable height (number of 8-foot saw logs)					
	1	2	3	4	5	6
	Number of standard cords of top wood per M board feet, Scribner					
Feet	Cords	Cords	Cords	Cords	Cords	Cords
30	1.2	.45				
40	2.2	.85	.40			
50	3.1	1.3	.70	.35		
60	4.0	1.8	1.0	.60	.30	
70	5.0	2.4	1.4	.80	.50	.35
80	6.1	2.9	1.8	1.2	.80	.60
90	7.1	3.5	2.3	1.5	1.1	.80
100	8.2	4.1	2.8	1.9	1.4	1.0

Example 1. An individual tree 80 feet in height with four 8-foot logs scaling 450 board feet, Scribner rule, will yield fuel wood at the rate of 1.2 cords per thousand board feet, or, for this particular tree, 0.54 standard cords ($\frac{450}{1000} \times 1.2 = 0.54$).

Example 2. A stand of hardwoods having an average height of 90 feet contains 85,000 board feet, Scribner rule. On the average, there are three 8-foot logs per tree. This stand will yield at the rate of 2.3 cords per thousand board feet, or, for the entire stand, 196 cords of stovewood ($\frac{85,000}{1,000} \times 2.3 = 196$).

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LAKE STATES FOREST EXPERIMENT STATION
S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Technical Note No. 185

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Cordwood Volume Table for Hardwoods

The table below shows the amount of wood in the entire stem above the stump and the entire top wood, including all branches, suitable for 16-inch stovewood. It is based on d.b.h. and total height of trees and is generally applicable to such hardwoods as maples, oaks, hickories, black walnut, elm, and ash. Volumes are in standard cords of 128 cubic feet.

D.B.H.	Volume in cords by total height of tree				
	20-foot trees	40-foot trees	60-foot trees	80-foot trees	100-foot trees
Inches	Cords	Cords	Cords	Cords	Cords
6	.01	.04	.05		
8	.05	.07	.10		
10	.10	.12	.17	.20	
12	.16	.19	.24	.30	.37
14	.23	.26	.34	.43	.53
16		.35	.44	.57	.70
18		.44	.55	.71	.90
20		.54	.69	.88	1.12
22		.65	.83	1.07	1.36
24		.78	.99	1.29	1.64
26		.92	1.18	1.52	1.96
28		1.08	1.38	1.80	2.30
30		1.25	1.60	2.08	2.65
32		1.43	1.83	2.38	3.03
34		1.62	2.06	2.70	3.43
36		1.83	2.30	3.03	3.90

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Thinnings Assume Commercial Importance

The war demands for wood products of all kinds have greatly increased the drain upon the forest. This tremendous demand makes it possible to remove low-quality timber which heretofore, because of lack of market, has been the stumbling block to improvement of the forest. Thinnings, for the first time, assume commercial importance. They open up new sources of wood, particularly for pulp, which hitherto were largely wasted.

The amount of timber that can be taken out through thinning is very large. Examination of three 40-acre tracts of young jack pine showed that out of a total volume of 36 cords per acre, over 40 percent, or 15 cords, was made up of inferior and otherwise defective trees which, however, could be used for pulpwood. If left uncut, these trees would be entirely wasted, aside from interfering with the growth of more promising trees. In a stand of young red pine, it was found that out of a total volume of 42 cords, 12 cords of inferior but largely merchantable material could be removed.

Such large amounts of material should not be removed at one time, but over a period of years, as otherwise the stand would be opened too drastically. This is not a theoretical calculation, as shown by the fact that during the past winter on the Chippewa National Forest, cuttings of 4 to 6 cords per acre in 38-year-old jack pine and 32-year-old aspen were found to be practical operations. In most cases it will be possible to make two or three such thinnings before the final crop matures.

March 1942

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

LAKE STATES FOREST EXPERIMENT STATION*
University Farm, St. Paul, Minnesota

Beginning with No. 181, the technical notes "for the duration" will be devoted to problems bearing on our WAR PROGRAM. They will include information on timber production and requirements; labor-saving techniques, opening up new sources of wood supply, and extending the use of wood.

Black Spruce Should Not Be Cut Clean

Spruce wood is the best kind for making paper pulp and commands the highest price on the market. Yet most Lake States black spruce forests are confined to swamps where conditions for growth are unfavorable and, therefore, growth is very small, often as low as one-tenth cord per acre per year. Many of the black spruce swamps may be classed as almost unproductive forest land. Any cutting method in black spruce which may improve its growth is, therefore, of decided advantage.

Studies conducted for the last six years indicate that, under proper methods of cutting, black spruce stands can be cut over every 20 years and yield 5 cords per acre. To obtain such a yield, black spruce stands must not be cut clean, but selectively. A removal at one time of 40 percent of the volume, about 8 cords per acre, leaves the remaining stand in condition to grow about one-fourth cord per acre per year, or about 5 cords in 20 years, an economically profitable cut for such a valuable species as black spruce. At present stumpage prices of about $2 per cord, this represents a return of 50 cents per acre per year - not a bad return from otherwise wasteland. An initial removal of only 25 percent of the original forest may increase the growth of the remaining stand even more.

Clean cutting, or very heavy cutting, on the other hand, in which the remaining trees soon die or are blown down by wind, is apt to convert swamps into wasteland for a century.

March 1942

* Maintained by the United States Department of Agriculture, St. Paul, Minnesota, in cooperation with the University of Minnesota.

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 188

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Jack Pine Reverts to Balsam Fir in Northeastern Minnesota

The cool climate and loamy soils of northeastern Minnesota are so favorable to the growth of balsam fir that this species gradually replaces jack pine when not burned over. Partial cutting in jack pine forests hastens the process of conversion to balsam fir.

This is clearly indicated by successive remeasurements in a series of experimental cutting plots established in a 60-year-old stand of pure jack pine on the Superior National Forest in 1925. The results are shown in the table.

Degree of cutting in 1926 (Percent of basal area)	Balsam fir trees per acre over 0.5 inch d.b.h.			
	1926	1931	1936	1941
0	0	6	50	160
49	4	12	76	210
60	8	18	190	330

It is evident from the table that partial cutting has stimulated the balsam. Many of the young balsam firs are approaching seed-bearing size, so the stocking of balsam fir can be expected to increase greatly during the next two or three decades. As a pulping wood, balsam fir is at least the equal of jack pine, so the change in species is not economically harmful.

By using care in logging to prevent unnecessary damage to advance reproduction, no further effort will be needed to insure restocking of many jack pine stands in northeastern Minnesota with balsam fir.

March 1942

TECHNICAL NOTES

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S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

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Upland Black Spruce Not a Stable Type

ntrary to general belief, upland black spruce in northern Minnesota is not stable type. It regenerates, as a general rule, after forest fires, and if ft alone in the course of time it reverts to a mixture of black spruce, lsam fir, jack pine, aspen, and paper birch. This tendency of pure black ruce to be succeeded by a mixed forest has been demonstrated in two cases ich were studied.

se 1.

1934, an almost pure stand was thinned 25 percent. Subsequent wind and ought damage opened it up another 15 percent. Seven years after the initial ening of the stand, the reproduction consisted of 1,000 black spruce per re, 520 aspen, 360 paper birch, and 120 of other kinds, chiefly jack pine d white pine. There would also be balsam fir reproduction, had there been lsam fir seed trees.

se 2.

65-year-old stand was cut clean. After 7 years, reproduction consisted of 600 black spruce per acre, 1,600 aspen, 600 paper birch, 250 jack pine, and 0 of other species. The trend is even more strikingly brought out where e soil was scarified mechanically on the cut-over area, causing an increase density of restocking for most species, viz., 3,000 black spruce, 1,400 pen, 1,400 paper birch, and 600 jack pine.

is clearly indicates that upland black spruce forms pure stands only when is burned over, and in time tends to become a mixed stand. This characteristic is important in management of upland black spruce since it makes ssible utilization of the faster-growing and earlier-maturing species such jack pine and aspen while leaving the longer-growing black spruce for ter cutting.

rch 1942

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 190

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Root Pruning - A Labor Saver

ith the certain prospect of continued shrinkage in the supply of labor for forest ursery operation, nurserymen are faced either with the necessity of adopting abor-saving methods or virtually abandoning the production of large-size planting tock. One promising labor-saving technique is root pruning in seed beds instead f transplanting.

he best type of root pruning consists of running a horizontal blade under the rees at a depth of 4 to 5 inches, and vertical blades between the rows. Results f tests on the Nicolet and Upper Michigan National Forests are shown in the table:

Species	Time of planting	Percent Survival: 2-1 transplants	Percent Survival: 3-0 seedlings, root pruned 1/
ed pine	Spring	84 - 98	82 - 97
hite pine	Spring	96 - 98	75 - 98
ed and white pine	Fall	85 - 90	73 - 80

/ Root pruned at beginning of third year.

he transplanted stock still has some advantage, particularly for fall planting. onsidering, however, that 2-1 stock costs about $6.50 per thousand, as compared ith about $2.50 per thousand for 3-0 seedlings, root pruning as a labor-saving echnique, especially in times of labor scarcity, may be worth while.

t is recommended that newly root-pruned seedlings be given an application of 50 pounds per acre of balanced fertilizer through the overhead water system ithin 1 to 4 weeks of root pruning to stimulate prompt recovery.

arch 1942

NTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

R.S. REFERENCE CO

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota

Michigan Lumber Production Largest Since 1929

1941 Lumber Production, by districts

1. East half of the Upper Peninsula.
2. West half of the Upper Peninsula.
3. North half of the Lower Peninsula.
4. South half of the Lower Peninsula.

Five hundred sixty-three active sawmills in Michigan produced 554 million board feet of lumber and ties in 1941, more than in any year since 1929, according to returns from the annual census of lumber production conducted by the Forest Service in cooperation with the Bureau of the Census. Excluding the smallest mills, cutting less than 50 thousand board feet, from which only partial returns were received, 1941 production exceeded 1940 by 30 percent and 1939 by 61 per cent.

Heaviest production, about 85 percent of the total, was in the Upper Peninsula of Michigan where most of the large mills and the old-growth timber are located (see map). Thus the old-growth northern hardwood species predominate: maple, hemlock, birch, pine, basswood and elm, in order of importance (table 2).

Conditions at the end of the year indicated continued and even expanded production during 1942 if the industry can adjust itself to wartime markets and restrictions.

A comparison of capacity of the mills with their 1941 output shows possibilities for expansion even beyond the 1941 level if war requirements demand it (table 1). Many of the larger mills could operate 2 or 3 shifts instead of only 1 or 2 and the smaller mills could operate more days per year if a concerted effort was made to facilitate logging and marketing of the lumber. Production might conceivably be pushed up to 700 or 800 million board feet per year, but that rate of output could not be maintained long without seriously depleting the timber resource, unless more conservative methods of cutting were adopted.

July 1942

1/ Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

Table 1.--Production of lumber, ties, lath, and shingles, in Michigan, by size of mill, 1941 (Preliminary)

Size of mill		Number of mills		Average capacity per 8 hr. day	Total production, 1941		
Class	Range in annual production per mill	Active	Idle		Lumber and ties	Lath	Shingles
				Thousand bd.ft	Thousand bd.ft.	Thousand pieces	Squares
1	Over 25 million bd.ft.....	2	0	81.0	1/	.....	.....
2	5 to 25 million bd.ft.....	25	0	37.0	374,595	5,921	6,22[illegible]
3	1 to 5 million bd.ft.....	49	1	12.0	100,742	5	.....
4	500 thousand to 1 million bd.ft.....	41	3	7.5	29,104	.....	100
5	50 thousand to 500 thousand bd.ft.....	279	21	5.0	45,839	1,590	1,74[illegible]
6	Under 50 thousand bd.ft. 2/	167	66	4.0	3,909	4	6,29[illegible]
	Total.....	563	91	.....	554,189	7,520	14,36[illegible]

1/ Combined with class 2 to avoid disclosing production of individual mills.
2/ Coverage incomplete.

Table 2.--Comparison of 1940 and 1941 production by species (mills cutting 50 thousand board feet or more)

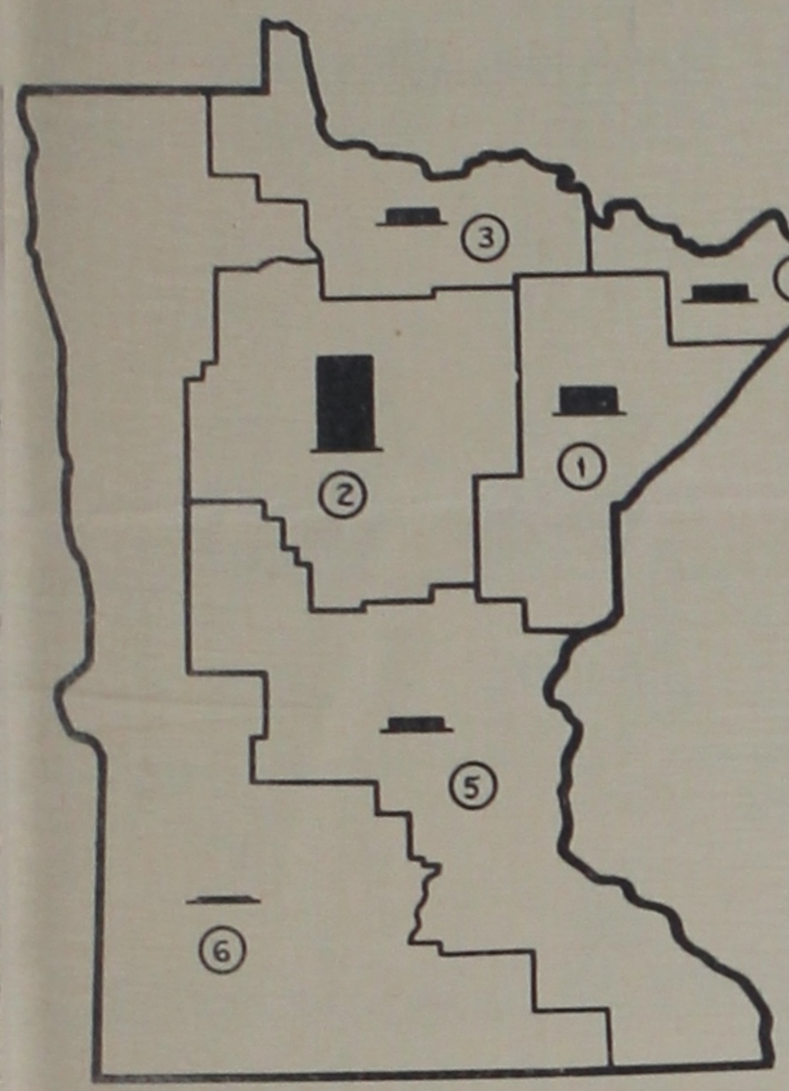
SOFTWOODS				HARDWOODS			
Species	Volume sawed 1940	Volume sawed 1941	Percent of increase + or decrease over 1940	Species	Volume sawed 1940	Volume sawed 1941	Percent of increase + or decrease over 1940
	Thousand bd.ft.	Thousand bd.ft.			Thousand bd.ft.	Thousand bd.ft.	
Pine 1/.....	24,976	32,809	+ 31.4	Maple.....	155,287	219,015	+ 41.0
Spruce.....	2,673	3,974	+ 48.7	Birch.....	45,987	60,296	+ 31.1
Balsam fir..	610	961	+ 57.5	Basswood.....	20,474	17,455	- 14.7
Tamarack....	377	455	+ 20.7	Elm.....	23,695	20,406	- 13.9
Hemlock.....	106,973	141,717	+ 32.5	Beech.....	9,340	14,627	+ 56.6
Cedar.....	1,367	2,149	+ 49.9	Oak.....	18,114	19,719	+ 8.9
				Aspen.....	5,453	9,511	+ 74.4
Total....	136,976	182,065	+ 32.9	Ash.....	6,105	5,674	- 7.1
				Miscellaneous	1,193	1,512	+ 26.7
				Total.....	285,648	368,215	+ 28.9
All species.....					422,624	550,280	+ 30.[illegible]

1/ Includes white, red, and jack pine.

DO NOT REFERENCE OR

LAKE STATES FOREST EXPERIMENT STATION [1]
University Farm, St. Paul, Minnesota

Minnesota Lumber Cut Largest in Eleven Years



Lumber Production by districts
1. Cloquet
2. Central Pine
3. Rainy River
4. Superior
5. Southern
6. Western

Six hundred and thirty-eight active sawmills in Minnesota produced 198 million board feet of lumber and ties in 1941, more than in any year since 1930, according to returns from the annual census of lumber production conducted by the U. S. Forest Service in cooperation with the Bureau of the Census. Excluding the smallest mills cutting less than 50 thousand board feet, from which only partial returns were received, 1941 production exceeded 1940 by 31 percent, and 1939 by 74 percent.

Expansion in production in 1941 was due to increasing demands for construction and box lumber, generated by the national-defense program.

Heaviest production was in the Central Pine district where most of the primary box mills are located (see map). Some of this increase, especially in pine, was possible because of salvage operations on the Chippewa National Forest, made necessary by the severe windstorm of July 1940. Pine production in this area has increased 107 percent since 1939, as compared with a 43 percent increase for the State as a whole (see table 2).

Conditions at the end of the year indicated continued and even expanding production during 1942 if the industry can adjust itself to wartime markets and restrictions. Table 2 shows that a number of the smaller mills were idle during the year because of changing conditions. These, together with many mills that were operated only part time, represent considerable idle capacity that could be utilized if war requirements demand it. Production could possibly be stepped up to 300 or even 400 million board feet for a year or two.

July 1942

1/ Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

Table 1.--Production of lumber, ties, lath, and shingles in Minnesota, by size of mill, 1941 (Preliminary)

Size of mill		Number of mills		Average capacity per 8-hr. day	Total production, 1941		
Class	Range in annual production per mill	Active	Idle		Lumber and ties	Lath	Shingles
				Thousand bd.ft.	Thousand bd.ft.	Thousand pieces	Squares
2	5 to 25 million bd.ft.....	5	....	28.2	29,828	1,228	.....
3	1 to 5 million bd.ft.....	37	....	11.0	69,584	150	.....
4	500 thousand to 1 million bd.ft.....	50	1	7.0	39,687	2,000	130
5	50 to 500 thousand bd.ft..	312	24	4.5	54,669	200	477
6	Under 50 thousand bd.ft.1/	234	86	3.1	4,334	3,840	795
	Total.....	638	111	.....	198,102	7,418	1,402

1/ Coverage incomplete.

Table 2.--Comparison of 1940 and 1941 production, by species (mills cutting 50 thousand board feet or more)

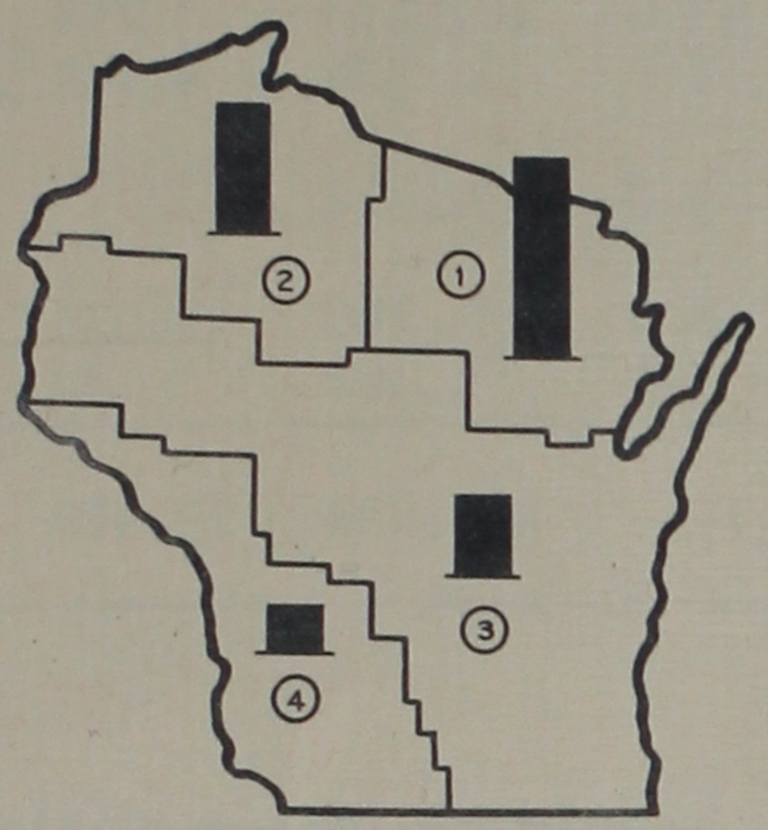
SOFTWOODS				HARDWOODS			
Species	Volume sawed 1940	Volume sawed 1941	Percent of increase + or decrease - over 1940	Species	Volume sawed 1940	Volume sawed 1941	Percent of increase + or decrease - over 1940
	Thousand bd.ft.	Thousand bd.ft.			Thousand bd.ft.	Thousand bd.ft.	
Pine 1/.....	79,863	114,112	+ 42.9	Maple.....	392	626	+ 59.7
Spruce.....	3,378	2,918	13.6	Birch.....	5,299	6,376	+ 20.3
Balsam fir..	2,711	2,047	- 24.5	Basswood....	3,433	3,607	+ 5.1
Tamarack ...	990	824	16.8	Elm.....	4,535	4,498	- 0.8
Hemlock.....	25	.....	.....	Oak.....	8,855	7,972	10.0
Cedar.....	5,468	2,906	46.8	Aspen.....	31,270	46,030	+ 47.2
				Ash.....	1,116	1,782	+ 59.7
Total....	92,435	122,807	+ 32.9	Miscellaneous	24	70	191.7
				Total	54,924	70,961	+ 29.2
All species.....					147,359	193,768	+ 31.5

1/ Includes white, red, and jack pine.

RS REFERENCE CO

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota

War Demands Strain Wisconsin Saw-Timber Resources



Lumber Production by districts

1. Northeastern
2. Northwestern
3. Central and southeastern
4. Southwestern

Six hundred and eighty-seven active sawmills in Wisconsin produced 462 million board feet of lumber and ties in 1941, more than in any year since 1930, according to returns from the annual census of lumber production conducted by the U. S. Forest Service in cooperation with the Bureau of the Census. Excluding the smallest mills, cutting less than 50 thousand board feet, from which only partial returns were received, 1941 production exceeded 1940 by 6 percent, and 1939 by 36 percent.

Output of many of the mills has been increased more than these figures would indicate, but this activity has been offset by the closing of several mills because of exhaustion of timber.

A comparison of mill capacity with 1941 output (table 1) indicates that Wisconsin mills could produce considerably more lumber to meet essential war demands if the war-time problems of logging and transporting the timber to the mills could be solved. However, a larger production could not be maintained for more than a few years because the State's timber resources are being depleted rapidly. Already a substantial proportion of the output of Wisconsin mills is from Michigan logs.

Table 2 shows a 20 percent increase in production of hemlock which is a major constituent of the remaining old growth forests of Wisconsin. Birch lumber production showed some decline in 1941 because of rising demands for birch veneer logs.

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Table 1.--Production of lumber, ties, lath and shingles in Wisconsin, by size of mill, 1941 (Preliminary)

Size of mill		Number of mills		Average capacity per 8-hr. day	Total production, 1941		
Class	Range in annual production per mill	Active	Idle		Lumber and ties	Lath	Shingles
				Thousand bd.ft.	Thousand bd.ft.	Thousand pieces	Squares
1	Over 25 million bd.ft.....	4	....	83.0	138,284	7,229	10,837
2	5 to 25 million bd.ft.....	12	....	33.0	127,670	3,714	1,838
3	1 to 5 million bd.ft.....	51	....	12.0	96,304	4,412	1,500
4	500 thousand to 1 million bd.ft.....	55	3	9.0	39,118	.....	500
5	50 thousand to 500 thousand bd.ft.....	303	24	6.0	55,146	4,035	1,692
6	Under 50 thousand bd.ft. 1/	262	100	3.5	5,122	98	8,826
	Total.....	687	127	.....	461,644	19,488	25,193

1/ Coverage incomplete.

Table 2.--Comparison of 1940 and 1941 production by species (mills cutting 50 thousand board feet or more)

SOFTWOODS				HARDWOODS			
Species	Volume sawed 1940	Volume sawed 1941	Percent of increase + or decrease - over 1940	Species	Volume sawed 1940	Volume sawed 1941	Percent of increase + or decrease - over 1940
	Thousand bd.ft.	Thousand bd.ft.			Thousand bd.ft.	Thousand bd.ft.	
Pine 1/.....	42,706	45,994	+ 7.8	Maple.....	75,137	81,046	+ 7.9
Spruce.....	870	862	- .9	Birch.....	46,861	43,680	- 6.8
Balsam fir..	363	303	- 16.5	Basswood.....	24,723	23,886	- 3.4
Tamarack....	772	924	+ 19.7	Elm.....	18,940	19,623	+ 3.6
Hemlock.....	136,497	164,165	+ 20.3	Beech.....	300	2,764	+ 821.3
Cedar.....	9,190	1,644	-821.1	Oak.....	57,751	51,142	- 11.4
Total.....	190,398	213,892	+ 12.3	Aspen.....	11,411	15,403	+ 35.0
				Ash.....	4,193	4,590	+ 9.5
				Miscellaneous	290	496	+ 71.0
All species	430,004	456,522	+ 6.2	Total.....	239,606	242,630	+ 1.3

1/ Includes white, red, and jack pine.

LAKE STATES FOREST EXPERIMENT STATION
University Farm, St. Paul, Minnesota 1/

Yields From Tie Bolts

The following guide table can be successfully used for estimating the number of ties and the amounts of side lumber, slabwood and edgings, and sawdust obtainable from an average run of acceptable 8-foot hardwood tie bolts of different top diameters.

Number of ties and additional products per 100 hardwood tie bolts of different top diameters

Top diameter of tie bolt i.b.	Number of ties per 100 bolts: Grade No. 1 (6"x6")	Grade No. 2 (6"x7")	Grade No. 3 (6"x8")	Grade No. 4 (7"x8")	Grade No. 5 (7"x9")	Side lumber	Slab-wood and edgings	Sawdust 1/
Inches	No.	No.	No.	No.	No.	B.M.	Std. cds.	Tons
9	100					405	1.8	1
10	20	80				495	2.2	1-1/3
11			60	40		594	2.6	1-2/3
12			10	70	20	702	3.1	2
13			5	35	60	819	3.6	2-1/4
14			5	30	65	945	4.2	2-2/3
15			80	30	30	1080	4.8	3
16			110	25	25	1224	5.4	3-1/3
17			110	45	25	1377	6.1	3-3/4
18			40	120	30	1539	6.8	4-1/4
19				120	80	1710	7.6	4-3/4
20				210	60	1890	8.4	5-1/4
21				170	120	2079	9.2	5-3/4
22				150	150	2277	10.1	6-1/3
23				140	180	2484	11.0	7
24				160	200	2700	12.0	7-1/2
25				150	250	2925	13.0	8

Weights based upon green oak wood. Reduce table values by 15 percent for birch and rock elm and by 12 percent for maple.

In preparing the table, it was assumed that rejects and doubtful cuts would not be included, and only losses resulting from invisible defect were considered. It was also assumed that the object is to secure the maximum number and highest grade ties possible.

Grades Nos. 1 and 2 are "pole" ties and are sawed on two sides only; grades Nos. 3, 4, and 5 are "square" ties and are sawed on four sides. The expected yield of tie sides will consist of lumber in random widths (4 inches and wider) and of various grades (No. 3 common and better). Lumber is sawed 1-1/8 inches in thickness when green.

February 1943

1/ Maintained by the U. S. Department of Agriculture, Forest Service at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota

Hemlock Tanbark Production Should be Increased

The recent restrictions placed on the sale of shoes has brought home to everyone the wartime scarcity of leather. Perhaps the prime factor in leather scarcity is the heavy demand for Army shoes and other leather goods, but an important secondary consideration is the decrease in shipments of imported tanning materials.

Until two or three decades ago, the chief sources of tannin for processing raw hides were the bark of native trees, mainly eastern hemlock, certain oaks, and the heartwood of chestnut. In more recent times cheaper foreign tannin materials have been the principal source of supply, although fortunately the domestic industry never ceased entirely.

Decreased shipments from abroad make possible again the use of our own hemlock tanbark. The price of and demand for hemlock bark has increased sharply during the past two years until now the peeling of hemlock bark probably can be made a profitable sideline of logging. Where hemlock is cut for pulpwood, there are the incentives that peeled wood commands a higher price and is cheaper to ship because of the drying that occurs after the bark has been removed. However, bark removed from small bolts is more difficult to stack and handle than from large logs. The best time for harvesting bark is during the regular pulpwood peeling season from May to early August. Winter cut logs can be peeled in the spring.

For those who engage in tanbark collection, the following information may be helpful.

Price of hemlock bark f.o.b. shipping point in Wisconsin, 1942 (per cord) approximately.....$10.50 - $11.00
Yield of bark (per 1000 board feet of logs).....About 1/2 cord
Weight of bark (per cord).....About 1 long ton
O.P.A. ceiling price for peeled hemlock pulpwood (per cord)....$11.00
O.P.A. ceiling price for unpeeled hemlock pulpwood (per cord)..$ 9.00
Shipping weight of unpeeled hemlock pulpwood (per cord).....4500 lbs.
Shipping weight of peeled hemlock pulpwood (per cord).....3400 lbs.

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 196

Harvesting Maple Syrup

Interest in the production and use of maple syrup, which has been stimulated by the wartime scarcity of sugar, calls attention to the fact that many opportunities have been overlooked for gathering this very palatable food in Michigan, Wisconsin and parts of Minnesota.

The commonest mistake in gathering the sap from sugar maple trees is to begin collecting too late in the season. The right time to start is in February or early March, depending upon the coldness of the winter. Later starting results in smaller yields and lower quality. The season of most active flow lasts for about one month.

Tapping of sugar maple trees, if limited to 1 to 4 holes per tree, depending on tree sizes, is not harmful to their health, although it causes some injury for lumber production. Open grown trees which have little value for lumber are especially good producers. The holes tapped in the tree should be less than 3 inches deep. Individual trees yield from 5 to 40 gallons of sap. It takes about 32 gallons of sap to make one gallon of concentrated syrup.

Recently the Office of Price Administration placed ceiling prices upon sales of maple syrup by producers and packers. Producers are permitted to charge packers from 14 to 19-1/2 cents per pound (approximately $1.54 to $2.14 per gallon) depending on grade and sugar content. Packers are allowed to charge from about $2.15 to $3.40 per gallon, depending on grade, quantity, size of containers, and class of users. The prices charged by wholesalers and retailers are governed by the General Maximum Price Regulations.

February 1943

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 197

How Many Pulpwood Bolts per Cord?

In estimating the volume of stacked wood it is frequently desirable to know how many bolts of different average diameters are required to produce one standard cord. The table below shows this for the principal pulpwood species in the Lake States.

The table applies to bolts cut in 8-foot lengths, and stacked unpeeled under conditions of close piling. The standard cord is that occupying 128 cubic feet of space (4x4x8 feet). Close piling here assumes 62 percent wood, 10 percent bark, and 28 percent void space, when bolts are piled unpeeled.

Average top diameter of bolts, inside bark	Spruce and balsam fir	Jack pine and red pine	Aspen	Hemlock
Inches	Number of unpeeled 8-foot bolts per standard cord 1/			
3	165	155	150	155
4	98	91	89	90
5	65	61	60	59
6	47	44	43	42
7	35	34	33	33
8	28	27	26	26
9	22	22	22	21
10	18	18	18	17
12	13	13	13	12
14	10	10	10	9
16	7	7	7	7
18	6	6	6	5
20	5	5	5	4

1/ If bolts are cut from open-grown trees, or loose piling is involved, smaller numbers of bolts are required, depending upon limbiness and crookedness.

Example: 1. Jack pine pulpwood averaging 5½ inches at the small end requires about 52 bolts per standard cord.

2. One standard cord of small aspen box bolts will contain about 32 bolts if their average diameter is slightly over 7 inches at the top.

February 1943 (Revised 1954) S. R. GEVORKIANTZ, Forester

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota

Taper Table I - Basswood

In estimating timber it is often necessary to know how many sawlogs, box bolts, veneer or tie bolts of different diameters can be cut from trees of various sizes and to determine the volume of these products separately. The table below, based on 1332 tree measurements, gives this information for basswood. It indicates the stem diameter inside bark at regular intervals above the ground. The stem diameters are expressed in percent of the tree diameter at breast height outside bark.

Height above ground	Merchantable height of tree in 16-foot logs 1/				
	1	2	3	4	5
	Top diameters inside bark in percent of DBH				
Feet	Percent	Percent	Percent	Percent	Percent
2.5	100	100	100	100	100
4.5	92	92	92	92	92
9	84	84	85	85	85
17	75	76	77	77	78
25	70	71	72	73	73
33		66	68	69	69
41		62	63	64	66
49			59	60	62
57			53	56	59
65				50	54
73				44	49
81					41
Basis (trees)	63	360	523	319	67

1/ Merchantable or usable height to a point on the stem where merchantability for sawtimber is limited by branches, deformity or by a diameter of less than 8.0 inches inside bark.

Example: The three 16-foot logs in a 3-log tree measuring 20 inches at breast height will have the following top diameters and volumes by the Scribner Rule:

1st log - 77 percent of d.b.h., or 15.4 inches, scaling 142 bd. ft.
2nd log - 68 percent of d.b.h., or 13.6 inches, scaling 114 bd. ft.
3rd log - 59 percent of d.b.h., or 11.8 inches, scaling 79 bd. ft.
335 bd. ft.

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LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota.

Taper Table II - Elm

In estimating timber it is often necessary to know how many sawlogs, box bolts, veneer or tie bolts of different diameters can be cut from trees of various sizes and to determine the volume of these products separately. The table below, based on 1022 tree measurements, gives this information for elm. It indicates the stem diameter inside bark at regular intervals above the ground. The stem diameters are expressed in percent of the tree diameter at breast height outside bark.

Height above ground	Merchantable height of tree in 16-foot logs 1/				
	1	2	3	4	5
	Top diameter inside bark in percent of DBH				
Feet	Percent	Percent	Percent	Percent	Percent
2	100	100	100	100	100
4.5	92	92	92	92	92
9	84	85	86	86	86
17	78	78	79	80	80
25	72	73	74	75	75
33		68	69	70	71
41		63	65	66	67
49			61	62	64
57			56	59	61
65				55	58
73				49	53
81					47
Basis (trees)	295	535	168	24	--

1/ Merchantable or usable height to a point on the stem where merchantability for sawtimber is limited by branches, deformity or by a diameter of less than 8.0 inches inside bark.

Example: The three 16-foot logs in a 3-log tree measuring 20 inches at breast height will have the following top diameters and volumes by the Scribner Rule:

1st log - 79 percent of d.b.h., or 15.8 inches, scaling	159	bd.ft.
2nd log - 69 percent of d.b.h., or 13.8 inches, scaling	114	bd.ft.
3rd log - 61 percent of d.b.h., or 12.1 inches, scaling	79	bd.ft.
	352	bd.ft.

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Technical Notes

No. 1980

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota

Tapery Table III - Oak, Red and White

In estimating timber it is often necessary to know how many sawlogs, box bolts, veneer or tie bolts of different diameters can be cut from trees of various sizes and to determine the volume of these products separately. The table below, based on 1659 tree measurements, gives this information for oak. It indicates the stem diameter inside bark at regular intervals above the ground. The stem diameters are expressed in percent of the tree diameter at breast height outside bark.

Height above ground	Merchantable height of tree in 16-foot logs 1/			
	1	2	3	4
	Top diameters inside bark in percent of DBH			
Feet	Percent	Percent	Percent	Percent
2	100	100	100	100
4.5	92	92	92	92
9	85	85	86	86
17	77	79	80	80
25	68	72	74	75
33		65	68	70
41		57	63	65
49			56	59
57			47	53
65				46
Basis (trees)	820	700	103	30

1/ Merchantable or usable height to a point on the stem where merchantability for sawtimber is limited by branches, deformity or by a diameter of less than 8.0 inches inside bark.

Example: The three 16-foot logs in a 3-log tree measuring 20 inches at breast height will have the following top diameters and volumes by the Scribner Rule:

1st log - 80 percent of d.b.h., or 16.0 inches, scaling 159 bd. ft.
2nd log - 68 percent of d.b.h., or 13.6 inches, scaling 114 bd. ft.
3rd log - 56 percent of d.b.h., or 11.2 inches, scaling 65 bd. ft.
338 bd. ft.

February 1943

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TECHNICAL NOTES

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Taper Table IV - Sugar Maple

In estimating timber it is often necessary to know how many sawlogs, box bolts, veneer or tie bolts of different diameters can be cut from trees of various sizes and to determine the volume of these products separately. The table below, based on 986 tree measurements, gives this information for sugar maple. It indicates the stem diameter inside bark at regular intervals above the ground. The stem diameters are expressed in percent of the tree diameter at breast height outside bark.

Height above ground	Merchantable height of tree in 16-foot logs 1/				
	1	2	3	4	5
	Top diameters inside bark in percent of DBH				
Feet	Percent	Percent	Percent	Percent	Percent
2	100	100	100	100	100
4.5	91	91	91	91	91
9	84	84	85	86	86
17	78	78	79	80	81
25	72	73	74	75	76
33		68	69	71	72
41		62	64	66	67
49			58	61	62
57			51	56	57
65				50	52
73				43	46
81					39
Basis (trees)	100	296	377	172	41

1/ Merchantable or usable height to a point on the stem where merchantability for sawtimber is limited by branches, deformity or by a diameter of less than 8.0 inches inside bark.

Example: The three 16-foot logs in a 3-log tree measuring 20 inches at breast height will have the following top diameters and volumes by the Scribner Rule:

1st log - 79 percent of d.b.h., or 15.8 inches, scaling	159	bd. ft.
2nd log - 69 percent of d.b.h., or 13.8 inches, scaling	114	bd. ft.
3rd log - 58 percent of d.b.h., or 11.6 inches, scaling	79	bd. ft.
	352	bd. ft.

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UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Taper Table V - Yellow Birch

In estimating timber it is often necessary to know how many sawlogs, box bolts, veneer or tie bolts of different diameters can be cut from trees of various sizes and to determine the volume of these products separately. The table below, based on 1078 tree measurements, gives this information for yellow birch. It indicates the stem diameter inside bark at regular intervals above the ground. The stem diameters are expressed in percent of the tree diameter at breast height outside bark.

Height above ground	Merchantable height of tree in 16-foot logs 1/				
	1	2	3	4	5
	Top diameters inside bark in percent of DBH				
Feet	Percent	Percent	Percent	Percent	Percent
2.5	100	100	100	100	100
4.5	93	93	93	93	93
9	85	85	85	86	86
17	78	78	79	80	81
25	72	73	74	74	75
33		68	69	69	70
41		62	63	64	65
49			56	58	60
57			49	52	54
65				42	46
73				31	36
81					23
Basis (trees)	403	555	110	10	--

1/ Merchantable or usable height to a point on the stem where merchantability for sawtimber is limited by branches, deformity or by a diameter of less than 8.0 inches inside bark.

Example: The three 16-foot logs in a 3-log tree measuring 20 inches at breast height will have the following top diameters and volumes by the Scribner Rule:

1st log - 79 percent of d.b.h., or 15.8 inches, scaling	159	bd. ft.
2nd log - 69 percent of d.b.h., or 13.8 inches, scaling	114	bd. ft.
3rd log - 56 percent of d.b.h., or 11.2 inches, scaling	65	bd. ft.
	338	bd. ft.

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LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota.

More Effective Measurement of Forest Fire Danger

Just as thermometers indicate temperature, fire danger meters are designed to indicate the degree of forest fire danger; as a guide to administrative action and as a basis for comparing the severity of conditions prevailing from time to time and from place to place.

The first crude meters recognized only a limited number of broad danger classes. By substituting measurement for guesswork in the determination of fire danger, however, danger meters have greatly increased the effectiveness of fire control and stimulated its development. In turn, this has resulted in a demand for more specific fire danger ratings. In response to this demand, a scale of one hundred equal danger units has been substituted in the Lake and Central States danger meters for the seven broad (geometrically increasing) danger classes formerly used.

The corresponding values of the old and new scales are as follows:

Original 7 broad danger classes	Average relative value	Range on new 100-point scale
1 - None	1	0 - 1+
2 - Very low	2	2 - 3
3 - Low	4	4 - 6
4 - Moderate	8	7 - 12
5 - High	16	13 - 24
6 - Very high	32	25 - 49
7 - Extreme	64	50 - 100

It is felt that the greater flexibility of the new scale and its closer and more direct relation to the degree of inflammability makes the change advisable.

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1/ Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota.

How the Forest Experiment Station Helps in the War Effort

What is the experiment station doing in the war effort? This is an often asked question. The answer is:

1. Watching the pulse of lumber production.
At the request of WPB the Station estimates current production of lumber once each month, based on canvasses of selected sample sawmills.

2. Analyzing the factors affecting lumber production.
The Station prepares a report for WPB, by three-month periods, explaining how various factors such as labor shortages, weather, prices, transportation, equipment problems, and repair difficulties are affecting production of lumber.

3. Reviving old uses of forest products.
The Station assisted in a survey of the hemlock tanbark industry to determine the possibilities of expanding it to compensate for decreased imports of leather tanning chemicals.

4. Exploring sources of raw materials.
Surveys have been made to locate timber for the greatly expanded box, cooperage, and chemical wood industries and to estimate supplies of timber suitable for aircraft veneer.

5. Stimulating the production of timber through advice to producers and by bringing timber owners and users together.
The Station has, in numerous instances, promoted the orderly production and movement of forest products by providing information on sources of stumpage, special market outlets, and procurement of equipment.

6. Collecting cost and price information.
From time to time information has been collected for OPA to use in setting or revising maximum price regulations.

7. Saving manpower through short-cut methods of scaling and cruising timber.
Information has been published showing how to save time in estimating standing timber or in scaling logs and bolts.

8. Measuring forest fire danger.
The effectiveness of forest fire control has been increased through the use of a fire danger meter, constructed by the Station, that shows the seriousness of burning conditions and by dispatching tables indicating the manpower required to control fires under specified conditions.

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1/ Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota.

Farmer Custom Sawing is Increasing

Farmers in the Lake States are meeting the prevailing lumber scarcity by having lumber sawed from timber grown in their own woodlands.

Huge orders of lumber for direct military use and falling production in the major commercial lumber producing regions have created a situation which makes it very difficult for farmers to get lumber for their current repair and replacement needs for barns, sheds, brooder houses, and other structures. However, by cutting logs on their own land and having them sawed in a local mill, many farmers have eliminated this difficulty. One custom sawmill operator recently estimated that his custom sawing had doubled this year.

Custom sawing by farmers for their own use has several desirable features. It permits farmers to realize on timber in their woodlands. It saves transportation and marketing costs. It eliminates unnecessary cash expenditures and makes the farms more self-sufficient. If properly planned so as not to interfere with other jobs, it helps to maintain continuous employment. Farm woodland timber frequently is not well suited for sale at good prices because of the small quantities of individual species and grades, but by using the timber on the farm the marketing and bargaining problems are eliminated.

In logging timber for custom sawing, farmers should not overlook the possibility of setting aside and selling occasional high grade logs which may be quite valuable. These include large clear white oak suited for ship timbers, large clear black walnut for veneer or propellor stock, hard maple and basswood of veneer or select lumber grade, and cottonwood veneer logs -- all products which are in great demand for military uses.

Precautions should be taken to cull out trees or logs suspected of containing spikes, staples, or fence wire. Sawing such logs causes damage to saws, resulting in delays and increased expenses.

ugust 1943

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LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota.

A Composite Cordwood Volume Table for the Lake States

A generalized cordwood volume table is now available that can be used for almost every species of timber in the Lake States. This table materially simplifies and shortens the task of computing volumes of bolt products, such as pulpwood.

The composite table is based on the fact that there is very little difference in the stacked volumes of most native trees in this region. Northern white cedar is the one native species which does fit closely and use of the table for that species therefore is not recommended.

DBH (inches)	Height in number of 8-foot bolts						
	1	2	3	4	5	6	7
	Volume in cords						
6	.02	.03	.04	.06			
7	.02	.04	.06	.08	.09		
8	.03	.05	.07	.09	.12	.14	
9	.04	.06	.09	.11	.14	.17	
10	.05	.07	.10	.13	.16	.20	.24
11	.06	.09	.12	.16	.19	.23	.28
12	.07	.10	.14	.18	.22	.27	.32
13	.08	.12	.16	.20	.25	.30	.36
14	.10	.13	.18	.23	.28	.34	.40

Volume is stem volume above one-foot stump in standard unpeeled cords.
Height is number of usable 8-foot bolts to a variable top diameter not less than 4 inches inside bark.

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1/ Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

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LAKE STATES FOREST EXPERIMENT STATION
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No. 203

Composite Board Foot Volume Tables for the Lake States

New board foot volume tables have been prepared which can be used for all species of sawtimber in the Lake States except beech and hemlock. These tables are based on the fact that where the same standards of utilization are employed differences in volume for most species are of no practical consequence, especially when other sources of error such as estimates of cull and merchantability are taken into consideration.

Beech overruns the table by about 18 percent and hemlock underruns the table as much as 15 percent in the smaller sizes.

Table I - Scribner Rule

DBH	Number of 16-foot logs per trees						
(inches)	½	1	1½	2	2½	3	4
10	14	30	40				
12	28	48	66	78	97		
14	40	70	96	116	141		
16	54	93	129	158	191	224	
18	72	122	168	207	248	292	355
20	90	156	212	262	317	366	451
22	111	194	262	328	392	452	563
24	137	236	319	399	472	549	687
26	165	281	381	478	566	653	820
28	195	331	448	559	665	764	959
30	227	383	522	648	772	886	1112
32	260	439	598	746	888	1019	1278
34	294	500	678	847	1009	1159	1455
36	330	564	767	955	1136	1307	1644
38	365	633	855	1068	1269	1463	1842
40	402	703	951	1183	1406	1631	2052

ump height is one foot. Height is the number of usable 16-foot logs to a riable top not smaller than 8 inches inside bark.

gust 1943

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Table II - International 1/4" Rule

DBH (Inches)	Number of 16-foot logs per tree: ½	1	1½	2	2½	3	4
	Volume - board feet						
10	17	39	53	68			
12	30	57	80	100			
14	42	79	110	140	163		
16	59	105	147	180	213	247	
18	74	135	188	235	278	320	400
20	92	170	236	295	350	402	499
22	112	209	290	362	430	494	613
24	133	252	346	431	512	594	742
26	158	300	409	508	604	698	880
28	187	348	478	597	705	812	1025
30	220	408	552	687	811	934	1180
35	311	566	773	954	1124	1294	1629
40	415	744	1007	1247	1475	1703	2155

Stump height is one foot. Height is the number of usable 16-foot logs to a variable top not smaller than 8 inches inside bark.

ESTIMATED LUMBER PRODUCTION 1/
1 9 4 2
LAKE STATES

Lake States Forest Experiment Station 2/
Forest Service, U. S. Department of Agriculture
In cooperation with the Bureau of the Census,
Department of Commerce and the Statistics
Division, War Production Board

Lake States Lumber Production Well Sustained in 1942

Lumber production in the Lake States was well sustained in 1942, according to an estimate based on the production of nearly 2,400 active sawmills. The amount of lumber produced in 1942 was about 1-1/4 billion feet, and was slightly in excess of the 1941 production.

Table 1.--Production of lumber, lath, and shingles, 1942

Species	Total	Michigan	Minnesota	Wisconsin
	Thousand board feet	Thousand board feet	Thousand board feet	Thousand board feet
Pine	220,619	35,227	131,664	53,728
Spruce	8,502	3,598	3,088	1,816
Balsam fir	3,094	645	2,003	446
Tamarack	3,341	290	2,010	1,041
Hemlock	260,653	128,597	.....	132,056
Cedar	6,398	2,759	2,424	1,215
Total softwoods	502,607	171,116	141,189	190,302
Maple	302,968	203,736	1,499	97,733
Birch	110,045	55,925	5,307	48,813
Basswood	51,050	16,636	6,371	28,043
Elm	47,989	18,858	6,337	22,794
Beech	22,264	20,832	.....	1,432
Oak	81,645	21,842	9,976	49,827
Aspen	115,081	16,124	60,649	38,308
Ash	12,588	4,369	2,393	5,826
Hickory	626	555	.....	71
Sycamore	88	44	.....	44
Walnut	160	104	.....	56
Yellow poplar	693	281	.....	412
Butternut	.....	.....	.....	.....
Cherry	458	440	.....	18
Miscellaneous	524	240	142	142
Total hardwoods	746,179	359,986	92,674	293,519
All species	1,248,786	531,102	233,863	483,821
Lath (M pieces)	50,511	5,166	4,937	40,408
Shingles (squares)	57,159	21,405	2,690	33,064

1/Preliminary data subject to revision. Final production statistics will be released by the Bureau of the Census.

2/Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

(Over)

Table 2.--Production according to mill size, 1942

Mill class	Production range	Number of mills				Production (Thousand board feet)		
		Minn.	Wis.	Mich.	Region	Softwood	Hardwood	Total
0	0 - 49 M	241	372	239	852	6,960	10,030	16,990
1	50 - 499 M	361	372	346	1,079	81,342	111,548	192,890
2	500 - 999 M	76	71	56	203	54,159	85,933	140,092
3	1,000 - 4,999 M	40	53	56	149	118,297	175,597	293,894
4	5,000 - 9,999 M	3	6	13	22	51,498	114,699	166,197
5	10,000 - 14,999 M	.....	4	7	11	40,977	101,108	142,085
6	15,000 - 24,999 M	.....	4	6	10	89,157	108,697	197,854
7	25,000 - 49,999 M	.....	3	.....	3	60,217	38,567	98,784
Idle	.....	168	227	215	610	.....	.....	.....
Total	.....	889	1,112	938	2,939	502,607	746,179	1,248,786

Table 3.--Comparison with preceding years 1/

Species	1939	1940	1941	1942
	Thousand board feet	Thousand board feet	Thousand board feet	Thousand board feet
Pine	113,603	147,545	193,512	216,606
Spruce	5,204	6,921	7,755	8,220
Balsam fir	2,480	3,684	3,299	2,779
Tamarack	2,785	2,139	2,171	3,165
Hemlock	201,401	243,495	308,393	258,824
Cedar	4,684	16,025	6,495	6,053
Total softwoods	330,157	419,809	521,625	495,647
Maple	198,792	230,816	308,191	301,891
Birch	70,964	98,147	111,804	109,777
Basswood	40,662	48,630	46,388	50,180
Elm	31,439	47,170	45,764	46,500
Beech	12,119	9,640	17,435	22,106
Oak	47,516	84,720	77,853	78,813
Aspen	40,872	48,134	70,203	112,246
Ash	7,541	11,414	11,973	12,184
Hickory	243	450	476	600
Sycamore	13	59	90	86
Walnut	151	207	164	147
Yellow poplar	224	226	137	666
Cherry	.....	.....	.....	455
Chestnut	15	168	.....	.....
Miscellaneous	541	397	553	498
Total hardwoods	451,092	580,178	691,031	736,149
All species	781,249	999,987	1,212,656	1,231,796

1/Data are limited to mills reporting production of 50 thousand board feet or more.

August 1943

ESTIMATED LUMBER PRODUCTION 1/
1 9 4 2
MICHIGAN

Lake States Forest Experiment Station 2/
Forest Service, U.S. Department of Agriculture
In cooperation with the Bureau of the Census,
Department of Commerce and the Statistics
Division, War Production Board

Michigan Lumber Production Declined Slightly in 1942

Lumber production in Michigan in 1942 was about 4 percent less than the 1941 production according to an estimate based on the production of over 700 active mills. The decline was altogether in the Upper Peninsula where 83 percent of the lumber was sawed.

Table 1.--Production of lumber, lath and shingles, 1942

Species	Upper Peninsula: West Half 1/	Upper Peninsula: East Half 2/	Upper Peninsula: Total	Lower Peninsula	Total
	Thousand board feet	Thousand board feet	Thousand board feet	Thousand board feet	Thousand board feet
Pine.....	16,173	10,909	27,082	8,145	35,227
Spruce.....	2,797	519	3,316	282	3,598
Balsam fir.....	37	192	229	416	645
Tamarack.....	119	21	140	150	290
Hemlock.....	90,488	34,261	124,749	3,848	128,597
Cedar.....	1,344	558	1,902	857	2,759
Total softwoods	110,958	46,460	157,418	13,698	171,116
Maple.....	123,535	56,644	180,179	23,557	203,736
Birch.....	38,425	16,671	55,096	829	55,925
Basswood.....	7,908	3,351	11,259	5,377	16,636
Elm.....	5,362	871	6,233	12,625	18,858
Beech.....	598	14,360	14,958	5,874	20,832
Oak.....	800	30	830	21,012	21,842
Aspen.....	8,013	4,650	12,663	3,461	16,124
Ash.....	2,350	179	2,529	1,840	4,369
Hickory.....	.....	.....	.....	555	555
Sycamore.....	10	.....	10	34	44
Walnut.....	.....	.....	.....	104	104
Cherry.....	3	17	20	420	440
Miscellaneous....	.....	1	1	520	521
Total hardwoods	187,004	96,774	283,778	76,208	359,986
All species.....	297,962	143,234	441,196	89,906	531,102
Lath (M pieces)..	2,430	2,377	4,807	359	5,166
Shingles (Squares)	7,582	6,220	13,802	7,603	21,405

1/Includes Baraga, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Marquette, and Ontonagon counties.
2/Includes Alger, Chippewa, Delta, Luce, Mackinac, Menominee and Schoolcraft counties.

1/Preliminary data subject to revision. Final production statistics will be released by the Bureau of the Census.

2/Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

(Over)

Table 1.--Production of lumber, ties, lath and shingles in Wisconsin, by size of mill, 1941 (Preliminary)

Size of mill		Number of mills		Average capacity per 8-hr. day	Total production, 1941		
Class	Range in annual production per mill	Active	Idle		Lumber and ties	Lath	Shingles
				Thousand bd.ft.	Thousand bd.ft.	Thousand pieces	Squares
1	Over 25 million bd.ft.....	4	....	83.0	138,284	7,229	10,837
2	5 to 25 million bd.ft.....	12	....	33.0	127,670	3,714	1,838
3	1 to 5 million bd.ft.....	51	....	12.0	96,304	4,412	1,500
4	500 thousand to 1 million bd.ft.....	55	3	9.0	39,118	.....	500
5	50 thousand to 500 thousand bd.ft.....	303	24	6.0	55,146	4,035	1,692
6	Under 50 thousand bd.ft. 1/	262	100	3.5	5,122	98	8,826
	Total.....	687	127	.....	461,644	19,488	25,193

1/ Coverage incomplete.

Table 2.--Comparison of 1940 and 1941 production by species (mills cutting 50 thousand board feet or more)

SOFTWOODS				HARDWOODS			
Species	Volume sawed 1940	Volume sawed 1941	Percent of increase + or decrease - over 1940	Species	Volume sawed 1940	Volume sawed 1941	Percent of increase + or decrease - over 1940
	Thousand bd.ft.	Thousand bd.ft.			Thousand bd.ft.	Thousand bd.ft.	
Pine 1/.....	42,706	45,994	+ 7.8	Maple.....	75,137	81,046	+ 7.9
Spruce.....	870	862	- .9	Birch.....	46,861	43,680	- 6.8
Balsam fir..	363	303	- 16.5	Basswood.....	24,723	23,886	- 3.4
Tamarack....	772	924	+ 19.7	Elm.....	18,940	19,623	+ 3.6
Hemlock.....	136,497	164,165	+ 20.3	Beech.....	300	2,764	+ 821.3
Cedar	9,190	1,644	-821.1	Oak.....	57,751	51,142	- 11.4
Total.....	190,398	213,892	+ 12.3	Aspen.....	11,411	15,403	+ 35.0
				Ash.....	4,193	4,590	+ 9.5
				Miscellaneous	290	496	+ 71.0
All species	430,004	456,522	+ 6.2	Total.....	239,606	242,630	+ 1.3

1/ Includes white, red, and jack pine.

LAKE STATES FOREST EXPERIMENT STATION
University Farm, St. Paul, Minnesota 1/

Yields From Tie Bolts

The following guide table can be successfully used for estimating the number of ties and the amounts of side lumber, slabwood and edgings, and sawdust obtainable from an average run of acceptable 8-foot hardwood tie bolts of different top diameters.

Number of ties and additional products per 100 hardwood tie bolts of different top diameters

Top diameter tie i.b.	Number of ties per 100 bolts: Grade No. 1 (6"x6")	Grade No. 2 (6"x7")	Grade No. 3 (6"x8")	Grade No. 4 (7"x8")	Grade No. 5 (7"x9")	Side lumber	Slab-wood and edgings	Sawdust 1/
ches	No.	No.	No.	No.	No.	B.M.	Std. cds.	Tons
						405	1.8	1
9	100					495	2.2	1-1/3
10	20	80				594	2.6	1-2/3
11			60	40		702	3.1	2
12			10	70	20	819	3.6	2-1/4
13			5	35	60	945	4.2	2-2/3
14			5	30	65	1080	4.8	3
15			80	30	30	1224	5.4	3-1/3
16			110	25	25	1377	6.1	3-3/4
17			110	45	25	1539	6.8	4-1/4
18			40	120	30	1710	7.6	4-3/4
19				120	80	1890	8.4	5-1/4
20				210	60	2079	9.2	5-3/4
21				170	120	2277	10.1	6-1/3
22				150	150	2484	11.0	7
23				140	180	2700	12.0	7-1/2
24				160	200	2925	13.0	8
25				150	250			

Weights based upon green oak wood. Reduce table values by 15 percent for birch and rock elm and by 12 percent for maple.

In preparing the table, it was assumed that rejects and doubtful cuts would not be included, and only losses resulting from invisible defect were considered. It was also assumed that the object is to secure the maximum number and highest grade ties possible.

Grades Nos. 1 and 2 are "pole" ties and are sawed on two sides only; grades Nos. 3, 4, and 5 are "square" ties and are sawed on four sides. The expected yield of tie sides will consist of lumber in random widths (4 inches and wider) and of various grades (No. 3 common and better). Lumber is sawed 1-1/8 inches in thickness when green.

February 1943

1/ Maintained by the U. S. Department of Agriculture, Forest Service at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota

Hemlock Tanbark Production Should be Increased

The recent restrictions placed on the sale of shoes has brought home to everyone the wartime scarcity of leather. Perhaps the prime factor in leather scarcity is the heavy demand for Army shoes and other leather goods, but an important secondary consideration is the decrease in shipments of imported tanning materials.

Until two or three decades ago, the chief sources of tannin for processing raw hides were the bark of native trees, mainly eastern hemlock, certain oaks, and the heartwood of chestnut. In more recent times cheaper foreign tannin materials have been the principal source of supply, although fortunately the domestic industry never ceased entirely.

Decreased shipments from abroad make possible again the use of our own hemlock tanbark. The price of and demand for hemlock bark has increased sharply during the past two years until now the peeling of hemlock bark probably can be made a profitable sideline of logging. Where hemlock is cut for pulpwood, there are the incentives that peeled wood commands a higher price and is cheaper to ship because of the drying that occurs after the bark has been removed. However, bark removed from small bolts is more difficult to stack and handle than from large logs. The best time for harvesting bark is during the regular pulpwood peeling season from May to early August. Winter cut logs can be peeled in the spring.

For those who engage in tanbark collection, the following information may be helpful.

Price of hemlock bark f.o.b. shipping point in Wisconsin, 1942 (per cord) approximately	$10.50 - $11.00
Yield of bark (per 1000 board feet of logs)	About 1/2 cord
Weight of bark (per cord)	About 1 long ton
O.P.A. ceiling price for peeled hemlock pulpwood (per cord)	$11.00
O.P.A. ceiling price for unpeeled hemlock pulpwood (per cord)	$ 9.00
Shipping weight of unpeeled hemlock pulpwood (per cord)	4500 lbs.
Shipping weight of peeled hemlock pulpwood (per cord)	3400 lbs.

February 1943

1/ Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 196

Harvesting Maple Syrup

Interest in the production and use of maple syrup, which has been stimulated by the wartime scarcity of sugar, calls attention to the fact that many opportunities have been overlooked for gathering this very palatable food in Michigan, Wisconsin and parts of Minnesota.

The commonest mistake in gathering the sap from sugar maple trees is to begin collecting too late in the season. The right time to start is in February or early March, depending upon the coldness of the winter. Later starting results in smaller yields and lower quality. The season of most active flow lasts for about one month.

Tapping of sugar maple trees, if limited to 1 to 4 holes per tree, depending on tree sizes, is not harmful to their health, although it causes some injury for lumber production. Open grown trees which have little value for lumber are especially good producers. The holes tapped in the tree should be less than 3 inches deep. Individual trees yield from 5 to 40 gallons of sap. It takes about 32 gallons of sap to make one gallon of concentrated syrup.

Recently the Office of Price Administration placed ceiling prices upon sales of maple syrup by producers and packers. Producers are permitted to charge packers from 14 to 19-1/2 cents per pound (approximately $1.54 to $2.14 per gallon) depending on grade and sugar content. Packers are allowed to charge from about $2.15 to $3.40 per gallon, depending on grade, quantity, size of containers, and class of users. The prices charged by wholesalers and retailers are governed by the General Maximum Price Regulations.

February 1943

INTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 197

How Many Pulpwood Bolts per Cord?

In estimating the volume of stacked wood it is frequently desirable to know how many bolts of different average diameters are required to produce one standard cord. The table below shows this for the principal pulpwood species in the Lake States.

The table applies to bolts cut in 8-foot lengths, and stacked unpeeled under conditions of close piling. The standard cord is that occupying 128 cubic feet of space (4x4x8 feet). Close piling here assumes 62 percent wood, 10 percent bark, and 28 percent void space, when bolts are piled unpeeled.

Average top diameter of bolts, inside bark	Spruce and balsam fir	Jack pine and red pine	Aspen	Hemlock
Inches	Number of unpeeled 8-foot bolts per standard cord 1/			
3	165	155	150	155
4	98	91	89	90
5	65	61	60	59
6	47	44	43	42
7	35	34	33	33
8	28	27	26	26
9	22	22	22	21
10	18	18	18	17
12	13	13	13	12
14	10	10	10	9
16	7	7	7	7
18	6	6	6	5
20	5	5	5	4

1/ If bolts are cut from open-grown trees, or loose piling is involved, smaller numbers of bolts are required, depending upon limbiness and crookedness.

Example: 1. Jack pine pulpwood averaging 5½ inches at the small end requires about 52 bolts per standard cord.

2. One standard cord of small aspen box bolts will contain about 32 bolts if their average diameter is slightly over 7 inches at the top.

February 1943 (Revised 1954) S. R. GEVORKIANTZ, Forester

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota

Taper Table I - Basswood

In estimating timber it is often necessary to know how many sawlogs, box bolts, veneer or tie bolts of different diameters can be cut from trees of various sizes and to determine the volume of these products separately. The table below, based on 1332 tree measurements, gives this information for basswood. It indicates the stem diameter inside bark at regular intervals above the ground. The stem diameters are expressed in percent of the tree diameter at breast height outside bark.

Height above ground	Merchantable height of tree in 16-foot logs 1/				
	1	2	3	4	5
	Top diameters inside bark in percent of DBH				
Feet	Percent	Percent	Percent	Percent	Percent
2.5	100	100	100	100	100
4.5	92	92	92	92	92
9	84	84	85	85	85
17	75	76	77	77	78
25	70	71	72	73	73
33		66	68	69	69
41		62	63	64	66
49			59	60	62
57			53	56	59
65				50	54
73				44	49
81					41
Basis (trees)	63	360	523	319	67

1/ Merchantable or usable height to a point on the stem where merchantability for sawtimber is limited by branches, deformity or by a diameter of less than 8.0 inches inside bark.

Example: The three 16-foot logs in a 3-log tree measuring 20 inches at breast height will have the following top diameters and volumes by the Scribner Rule:

1st log - 77 percent of d.b.h., or 15.4 inches, scaling 142 bd. ft.
2nd log - 68 percent of d.b.h., or 13.6 inches, scaling 114 bd. ft.
3rd log - 59 percent of d.b.h., or 11.8 inches, scaling 79 bd. ft.
335 bd. ft.

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1/ Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota.

Taper Table II - Elm

In estimating timber it is often necessary to know how many sawlogs, box bolts, veneer or tie bolts of different diameters can be cut from trees of various sizes and to determine the volume of these products separately. The table below, based on 1022 tree measurements, gives this information for elm. It indicates the stem diameter inside bark at regular intervals above the ground. The stem diameters are expressed in percent of the tree diameter at breast height outside bark.

Height above ground	Merchantable height of tree in 16-foot logs 1/				
	1	2	3	4	5
	Top diameter inside bark in percent of DBH				
Feet	Percent	Percent	Percent	Percent	Percent
2	100	100	100	100	100
4.5	92	92	92	92	92
9	84	85	86	86	86
17	78	78	79	80	80
25	72	73	74	75	75
33		68	69	70	71
41		63	65	66	67
49			61	62	64
57			56	59	61
65				55	58
73				49	53
81					47
Basis (trees)	295	535	168	24	--

1/ Merchantable or usable height to a point on the stem where merchantability for sawtimber is limited by branches, deformity or by a diameter of less than 8.0 inches inside bark.

Example: The three 16-foot logs in a 3-log tree measuring 20 inches at breast height will have the following top diameters and volumes by the Scribner Rule:

1st log - 79 percent of d.b.h., or 15.8 inches, scaling	159	bd.ft.
2nd log - 69 percent of d.b.h., or 13.8 inches, scaling	114	bd.ft.
3rd log - 61 percent of d.b.h., or 12.1 inches, scaling	79	bd.ft.
	352	bd.ft.

February 1943

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LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota

Taper Table III - Oak, Red and White

In estimating timber it is often necessary to know how many sawlogs, box bolts, veneer or tie bolts of different diameters can be cut from trees of various sizes and to determine the volume of these products separately. The table below, based on 1659 tree measurements, gives this information for oak. It indicates the stem diameter inside bark at regular intervals above the ground. The stem diameters are expressed in percent of the tree diameter at breast height outside bark.

Height above ground	Merchantable height of tree in 16-foot logs 1/			
	1	2	3	4
	Top diameters inside bark in percent of DBH			
Feet	Percent	Percent	Percent	Percent
2	100	100	100	100
4.5	92	92	92	92
9	85	85	86	86
17	77	79	80	80
25	68	72	74	75
33		65	68	70
41		57	63	65
49			56	59
57			47	53
65				46
Basis (trees)	820	700	103	30

1/ Merchantable or usable height to a point on the stem where merchantability for sawtimber is limited by branches, deformity or by a diameter of less than 8.0 inches inside bark.

Example: The three 16-foot logs in a 3-log tree measuring 20 inches at breast height will have the following top diameters and volumes by the Scribner Rule:

1st log - 80 percent of d.b.h., or 16.0 inches, scaling 159 bd. ft.
2nd log - 68 percent of d.b.h., or 13.6 inches, scaling 114 bd. ft.
3rd log - 56 percent of d.b.h., or 11.2 inches, scaling 65 bd. ft.
338 bd. ft.

February 1943

1/ Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
No. 198D
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Taper Table IV - Sugar Maple

In estimating timber it is often necessary to know how many sawlogs, box bolts, veneer or tie bolts of different diameters can be cut from trees of various sizes and to determine the volume of these products separately. The table below, based on 986 tree measurements, gives this information for sugar maple. It indicates the stem diameter inside bark at regular intervals above the ground. The stem diameters are expressed in percent of the tree diameter at breast height outside bark.

Height above ground	Merchantable height of tree in 16-foot logs 1/				
	1	2	3	4	5
	Top diameters inside bark in percent of DBH				
Feet	Percent	Percent	Percent	Percent	Percent
2	100	100	100	100	100
4.5	91	91	91	91	91
9	84	84	85	86	86
17	78	78	79	80	81
25	72	73	74	75	76
33		68	69	71	72
41		62	64	66	67
49			58	61	62
57			51	56	57
65				50	52
73				43	46
81					39
Basis (trees)	100	296	377	172	41

1/ Merchantable or usable height to a point on the stem where merchantability for sawtimber is limited by branches, deformity or by a diameter of less than 8.0 inches inside bark.

Example: The three 16-foot logs in a 3-log tree measuring 20 inches at breast height will have the following top diameters and volumes by the Scribner Rule:

1st log - 79 percent of d.b.h., or 15.8 inches, scaling	159	bd. ft.
2nd log - 69 percent of d.b.h., or 13.8 inches, scaling	114	bd. ft.
3rd log - 58 percent of d.b.h., or 11.6 inches, scaling	79	bd. ft.
	352	bd. ft.

February 1943

1/ Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION

U. S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE

No. 188E

UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Taper Table V - Yellow Birch

In estimating timber it is often necessary to know how many sawlogs, box bolts, veneer or tie bolts of different diameters can be cut from trees of various sizes and to determine the volume of these products separately. The table below, based on 1078 tree measurements, gives this information for yellow birch. It indicates the stem diameter inside bark at regular intervals above the ground. The stem diameters are expressed in percent of the tree diameter at breast height outside bark.

Height above ground	Merchantable height of tree in 16-foot logs 1/				
	1	2	3	4	5
	Top diameters inside bark in percent of DBH				
Feet	Percent	Percent	Percent	Percent	Percent
2.5	100	100	100	100	100
4.5	93	93	93	93	93
9	85	85	85	86	86
17	78	78	79	80	81
25	72	73	74	74	75
33		68	69	69	70
41		62	63	64	65
49			56	58	60
57			49	52	54
65				42	46
73				31	36
81					23
Basis (trees)	403	555	110	10	--

1/ Merchantable or usable height to a point on the stem where merchantability for sawtimber is limited by branches, deformity or by a diameter of less than 8.0 inches inside bark.

Example: The three 16-foot logs in a 3-log tree measuring 20 inches at breast height will have the following top diameters and volumes by the Scribner Rule:

1st log - 79 percent of d.b.h., or 15.8 inches, scaling	159	bd. ft.
2nd log - 69 percent of d.b.h., or 13.8 inches, scaling	114	bd. ft.
3rd log - 56 percent of d.b.h., or 11.2 inches, scaling	65	bd. ft.
	338	bd. ft.

February 1943

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota.

More Effective Measurement of Forest Fire Danger

Just as thermometers indicate temperature, fire danger meters are designed to indicate the degree of forest fire danger; as a guide to administrative action and as a basis for comparing the severity of conditions prevailing from time to time and from place to place.

The first crude meters recognized only a limited number of broad danger classes. By substituting measurement for guesswork in the determination of fire danger, however, danger meters have greatly increased the effectiveness of fire control and stimulated its development. In turn, this has resulted in a demand for more specific fire danger ratings. In response to this demand, a scale of one hundred equal danger units has been substituted in the Lake and Central States danger meters for the seven broad (geometrically increasing) danger classes formerly used.

The corresponding values of the old and new scales are as follows:

Original 7 broad danger classes	Average relative value	Range on new 100-point scale
1 - None	1	0 - 1+
2 - Very low	2	2 - 3
3 - Low	4	4 - 6
4 - Moderate	8	7 - 12
5 - High	16	13 - 24
6 - Very high	32	25 - 49
7 - Extreme	64	50 - 100

It is felt that the greater flexibility of the new scale and its closer and more direct relation to the degree of inflammability makes the change advisable.

February 1943

1/ Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota.

How the Forest Experiment Station Helps in the War Effort

What is the experiment station doing in the war effort? This is an often asked question. The answer is:

1. Watching the pulse of lumber production.
At the request of WPB the Station estimates current production of lumber once each month, based on canvasses of selected sample sawmills.

2. Analyzing the factors affecting lumber production.
The Station prepares a report for WPB, by three-month periods, explaining how various factors such as labor shortages, weather, prices, transportation, equipment problems, and repair difficulties are affecting production of lumber.

3. Reviving old uses of forest products.
The Station assisted in a survey of the hemlock tanbark industry to determine the possibilities of expanding it to compensate for decreased imports of leather tanning chemicals.

4. Exploring sources of raw materials.
Surveys have been made to locate timber for the greatly expanded box, cooperage, and chemical wood industries and to estimate supplies of timber suitable for aircraft veneer.

5. Stimulating the production of timber through advice to producers and by bringing timber owners and users together.
The Station has, in numerous instances, promoted the orderly production and movement of forest products by providing information on sources of stumpage, special market outlets, and procurement of equipment.

6. Collecting cost and price information.
From time to time information has been collected for OPA to use in setting or revising maximum price regulations.

7. Saving manpower through short-cut methods of scaling and cruising timber.
Information has been published showing how to save time in estimating standing timber or in scaling logs and bolts.

8. Measuring forest fire danger.
The effectiveness of forest fire control has been increased through the use of a fire danger meter, constructed by the Station, that shows the seriousness of burning conditions and by dispatching tables indicating the manpower required to control fires under specified conditions.

August 1943

1/ Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota.

Farmer Custom Sawing is Increasing

Farmers in the Lake States are meeting the prevailing lumber scarcity by having lumber sawed from timber grown in their own woodlands.

Huge orders of lumber for direct military use and falling production in the major commercial lumber producing regions have created a situation which makes it very difficult for farmers to get lumber for their current repair and replacement needs for barns, sheds, brooder houses, and other structures. However, by cutting logs on their own land and having them sawed in a local mill, many farmers have eliminated this difficulty. One custom sawmill operator recently estimated that his custom sawing had doubled this year.

Custom sawing by farmers for their own use has several desirable features. It permits farmers to realize on timber in their woodlands. It saves transportation and marketing costs. It eliminates unnecessary cash expenditures and makes the farms more self-sufficient. If properly planned so as not to interfere with other jobs, it helps to maintain continuous employment. Farm woodland timber frequently is not well suited for sale at good prices because of the small quantities of individual species and grades, but by using the timber on the farm the marketing and bargaining problems are eliminated.

In logging timber for custom sawing, farmers should not overlook the possibility of setting aside and selling occasional high grade logs which may be quite valuable. These include large clear white oak suited for ship timbers, large clear black walnut for veneer or propellor stock, hard maple and basswood of veneer or select lumber grade, and cottonwood veneer logs -- all products which are in great demand for military uses.

Precautions should be taken to cull out trees or logs suspected of containing spikes, staples, or fence wire. Sawing such logs causes damage to saws, resulting in delays and increased expenses.

ugust 1943

1/ Maintained by the United States Department of Agriculture, Forest ervice, at University Farm, St. Paul, Minnesota, in cooperation with the niversity of Minnesota.

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul, Minnesota.

A Composite Cordwood Volume Table for the Lake States

A generalized cordwood volume table is now available that can be used for almost every species of timber in the Lake States. This table materially simplifies and shortens the task of computing volumes of bolt products, such as pulpwood.

The composite table is based on the fact that there is very little difference in the stacked volumes of most native trees in this region. Northern white cedar is the one native species which does fit closely and use of the table for that species therefore is not recommended.

DBH	Height in number of 8-foot bolts						
	1	2	3	4	5	6	7
(inches)	Volume in cords						
6	.02	.03	.04	.06			
7	.02	.04	.06	.08	.09		
8	.03	.05	.07	.09	.12	.14	
9	.04	.06	.09	.11	.14	.17	
10	.05	.07	.10	.13	.16	.20	.24
11	.06	.09	.12	.16	.19	.23	.28
12	.07	.10	.14	.18	.22	.27	.32
13	.08	.12	.16	.20	.25	.30	.36
14	.10	.13	.18	.23	.28	.34	.40

Volume is stem volume above one-foot stump in standard unpeeled cords.
Height is number of usable 8-foot bolts to a variable top diameter not less than 4 inches inside bark.

August 1943

1/ Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 1, MINNESOTA
No. 203

Composite Board Foot Volume Tables for the Lake States

New board foot volume tables have been prepared which can be used for all species of sawtimber in the Lake States except beech and hemlock. These tables are based on the fact that where the same standards of utilization are employed differences in volume for most species are of no practical consequence, especially when other sources of error such as estimates of cull and merchantability are taken into consideration.

Beech overruns the table by about 18 percent and hemlock underruns the table as much as 15 percent in the smaller sizes.

Table I - Scribner Rule

DBH	Number of 16-foot logs per trees						
(inches)	½	1	1½	2	2½	3	4
10	14	30	40				
12	28	48	66	78	97		
14	40	70	96	116	141		
16	54	93	129	158	191	224	
18	72	122	168	207	248	292	355
20	90	156	212	262	317	366	451
22	111	194	262	328	392	452	563
24	137	236	319	399	472	549	687
26	165	281	381	478	566	653	820
28	195	331	448	559	665	764	959
30	227	383	522	648	772	886	1112
32	260	439	598	746	888	1019	1278
34	294	500	678	847	1009	1159	1455
36	330	564	767	955	1136	1307	1644
38	365	633	855	1068	1269	1463	1842
40	402	703	951	1183	1406	1631	2052

ump height is one foot. Height is the number of usable 16-foot logs to a riable top not smaller than 8 inches inside bark.

gust 1943

NTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Table II - International 1/4" Rule

DBH (Inches)	Number of 16-foot logs per tree						
	½	1	1½	2	2½	3	4
	Volume - board feet						
10	17	39	53	68			
12	30	57	80	100			
14	42	79	110	140	163		
16	59	105	147	180	213	247	
18	74	135	188	235	278	320	400
20	92	170	236	295	350	402	499
22	112	209	290	362	430	494	613
24	133	252	346	431	512	594	742
26	158	300	409	508	604	698	880
28	187	348	478	597	705	812	1025
30	220	408	552	687	811	934	1180
35	311	566	773	954	1124	1294	1629
40	415	744	1007	1247	1475	1703	2155

Stump height is one foot. Height is the number of usable 16-foot logs to a variable top not smaller than 8 inches inside bark.

ESTIMATED LUMBER PRODUCTION 1/
1 9 4 2
LAKE STATES

Lake States Forest Experiment Station 2/
Forest Service, U. S. Department of Agriculture
In cooperation with the Bureau of the Census,
Department of Commerce and the Statistics
Division, War Production Board

Lake States Lumber Production Well Sustained in 1942

Lumber production in the Lake States was well sustained in 1942, according to an estimate based on the production of nearly 2,400 active sawmills. The amount of lumber produced in 1942 was about 1-1/4 billion feet, and was slightly in excess of the 1941 production.

Table 1.--Production of lumber, lath, and shingles, 1942

Species	Total	Michigan	Minnesota	Wisconsin
	Thousand board feet	Thousand board feet	Thousand board feet	Thousand board feet
Pine	220,619	35,227	131,664	53,728
Spruce	8,502	3,598	3,088	1,816
Balsam fir	3,094	645	2,003	446
Tamarack	3,341	290	2,010	1,041
Hemlock	260,653	128,597	.....	132,056
Cedar	6,398	2,759	2,424	1,215
Total softwoods	502,607	171,116	141,189	190,302
Maple	302,968	203,736	1,499	97,733
Birch	110,045	55,925	5,307	48,813
Basswood	51,050	16,636	6,371	28,043
Elm	47,989	18,858	6,337	22,794
Beech	22,264	20,832	.....	1,432
Oak	81,645	21,842	9,976	49,827
Aspen	115,081	16,124	60,649	38,308
Ash	12,588	4,369	2,393	5,826
Hickory	626	555	.....	71
Sycamore	88	44	.....	44
Walnut	160	104	.....	56
Yellow poplar	693	281	.....	412
Butternut	.....	.....	.....	.....
Cherry	458	440	.....	18
Miscellaneous	524	240	142	142
Total hardwoods	746,179	359,986	92,674	293,519
All species	1,248,786	531,102	233,863	483,821
Lath (M pieces)	50,511	5,166	4,937	40,408
Shingles (squares)	57,159	21,405	2,690	33,064

1/Preliminary data subject to revision. Final production statistics will be released by the Bureau of the Census.

2/Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

(Over)

Table 2.--Production according to mill size, 1942

Mill class	Production range	Number of mills				Production (Thousand board feet)		
		Minn.	Wis.	Mich.	Region	Softwood	Hardwood	Total
0	0 - 49 M	241	372	239	852	6,960	10,030	16,990
1	50 - 499 M	361	372	346	1,079	81,342	111,548	192,890
2	500 - 999 M	76	71	56	203	54,159	85,933	140,092
3	1,000 - 4,999 M	40	53	56	149	118,297	175,597	293,894
4	5,000 - 9,999 M	3	6	13	22	51,498	114,699	166,197
5	10,000 - 14,999 M	.....	4	7	11	40,977	101,108	142,085
6	15,000 - 24,999 M	.....	4	6	10	89,157	108,697	197,854
7	25,000 - 49,999 M	.....	3	.....	3	60,217	38,567	98,784
Idle	.....	168	227	215	610	.....	.....	.....
Total	.....	889	1,112	938	2,939	502,607	746,179	1,248,786

Table 3.--Comparison with preceding years 1/

Species	1939	1940	1941	1942
	Thousand board feet	Thousand board feet	Thousand board feet	Thousand board feet
Pine	113,603	147,545	193,512	216,606
Spruce	5,204	6,921	7,755	8,220
Balsam fir	2,480	3,684	3,299	2,779
Tamarack	2,785	2,139	2,171	3,165
Hemlock	201,401	243,495	308,393	258,824
Cedar	4,684	16,025	6,495	6,053
Total softwoods	330,157	419,809	521,625	495,647
Maple	198,792	230,816	308,191	301,891
Birch	70,964	98,147	111,804	109,777
Basswood	40,662	48,630	46,388	50,180
Elm	31,439	47,170	45,764	46,500
Beech	12,119	9,640	17,435	22,106
Oak	47,516	84,720	77,853	78,813
Aspen	40,872	48,134	70,203	112,246
Ash	7,541	11,414	11,973	12,184
Hickory	243	450	476	600
Sycamore	13	59	90	86
Walnut	151	207	164	147
Yellow poplar	224	226	137	666
Cherry	.....	.....	.....	455
Chestnut	15	168	.....	.....
Miscellaneous	541	397	553	498
Total hardwoods	451,092	580,178	691,031	736,149
All species	781,249	999,987	1,212,656	1,231,796

1/Data are limited to mills reporting production of 50 thousand board feet or more.

August 1943

ESTIMATED LUMBER PRODUCTION 1/
1 9 4 2
MICHIGAN

Lake States Forest Experiment Station 2/
Forest Service, U.S. Department of Agriculture
In cooperation with the Bureau of the Census,
Department of Commerce and the Statistics
Division, War Production Board

Michigan Lumber Production Declined Slightly in 1942

Lumber production in Michigan in 1942 was about 4 percent less than the 1941 production according to an estimate based on the production of over 700 active mills. The decline was altogether in the Upper Peninsula where 83 percent of the lumber was sawed.

Table 1.--Production of lumber, lath and shingles, 1942

Species	Upper Peninsula: West Half 1/	Upper Peninsula: East Half 2/	Upper Peninsula: Total	Lower Peninsula	Total
	Thousand board feet	Thousand board feet	Thousand board feet	Thousand board feet	Thousand board feet
Pine.....	16,173	10,909	27,082	8,145	35,227
Spruce.....	2,797	519	3,316	282	3,598
Balsam fir.....	37	192	229	416	645
Tamarack.....	119	21	140	150	290
Hemlock.....	90,488	34,261	124,749	3,848	128,597
Cedar.....	1,344	558	1,902	857	2,759
Total softwoods	110,958	46,460	157,418	13,698	171,116
Maple.....	123,535	56,644	180,179	23,557	203,736
Birch.....	38,425	16,671	55,096	829	55,925
Basswood.....	7,908	3,351	11,259	5,377	16,636
Elm.....	5,362	871	6,233	12,625	18,858
Beech.....	598	14,360	14,958	5,874	20,832
Oak.....	800	30	830	21,012	21,842
Aspen.....	8,013	4,650	12,663	3,461	16,124
Ash.....	2,350	179	2,529	1,840	4,369
Hickory.....	.....	.....	.....	555	555
Sycamore.....	10	.....	10	34	44
Walnut.....	.....	.....	.....	104	104
Cherry.....	3	17	20	420	440
Miscellaneous....	.....	1	1	520	521
Total hardwoods	187,004	96,774	283,778	76,208	359,986
All species.....	297,962	143,234	441,196	89,906	531,102
Lath (M pieces)..	2,430	2,377	4,807	359	5,166
Shingles (Squares)	7,582	6,220	13,802	7,603	21,405

1/Includes Baraga, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Marquette, and Ontonagon counties.
2/Includes Alger, Chippewa, Delta, Luce, Mackinac, Menominee and Schoolcraft counties.

1/Preliminary data subject to revision. Final production statistics will be released by the Bureau of the Census.

2/Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

(Over)

Table 2.--Production by size of mill, 1942

Mill class	Production range	Number of mills: Upper Peninsula: West	East	Total	Lower Peninsula	State total	Production (Thousand board feet): Softwood	Hardwood	Total
0	0 - 49 M	45	41	86	153	239	1,901	3,062	4,963
1	50 - 499 M	64	42	106	240	346	17,871	42,454	60,325
2	500 - 999 M	16	8	24	32	56	10,303	30,445	40,748
3	1,000 - 4,999 M	27	17	44	12	56	33,615	73,403	107,018
4	5,000 - 9,999 M	8	4	12	1	13	23,305	83,369	106,674
5	10,000 - 14,999 M	4	3	7	.....	7	28,590	64,852	93,442
6	15,000 - 24,999 M	5	1	6	.....	6	55,531	62,401	117,932
Idle	.....	51	41	92	123	215	.....	.....	.....
Total	.....	220	157	377	561	938	171,116	359,986	531,102

Table 3.--Production by county

County	Number active mills	Production (Thousand board feet)	County	Number active mills	Production (Thousand board feet)
Alger.....	9	15,819	Lake, Mason°.....	8	1,153
Alcona, Alpena°.....	16	2,699	Lapeer, Genesee°.....	15	7,632
Allegan.....	8	1,653	Leelanau.....	6	1,757
Antrim, Charlevoix.°..	7	11,151	Livingston, Oakland°..	13	5,085
Baraga.....	16	39,631	Luce.....	5	21,540
Barry.....	9	1,988	Mackinac.....	15	18,743
Bay.....	9	1,538	Macomb.....	5	937
Benzie.....	7	1,049	Manistee.....	11	1,674
Berrien.....	6	213	Marquette.....	34	39,934
Branch, Calhoun°.....	10	1,617	Mecosta, Midland°....	7	572
Cass.....	5	1,506	Menominee.....	28	19,202
Cheboygan, Emmet°.....	6	1,174	Missaukee.....	5	319
Chippewa.....	24	18,604	Monroe, Wayne°.....	7	1,017
Clare, Arenac, Gladwin°	11	475	Montcalm, Isabella°..	10	1,057
Clinton.....	10	1,525	Montmorency, Otsego and Presque Isle°..	8	1,247
Crawford.....	9	1,210	Muskegon.....	11	1,873
Delta.....	20	37,910	Newaygo.....	6	1,374
Dickinson.....	17	32,671	Oceana.....	10	1,888
Eaton.....	7	3,578	Ontonagon.....	19	49,384
Gogebic.....	21	83,559	Ogemaw.....	6	522
Grand Traverse.....	6	1,473	Osceola.....	7	760
Gratiot.....	7	997	Oscoda.....	8	943
Hillsdale.....	5	909	Ottawa.....	6	1,589
Houghton.....	31	37,355	Roscommon, Wexford.°.	7	1,181
Huron.....	10	568	Saginaw.....	17	4,026
Ingham.....	8	998	St. Clair.....	9	412
Ionia.....	5	685	St. Joseph.....	6	447
Iosco.....	14	954	Sanilac.....	12	1,329
Iron.....	22	13,671	Schoolcraft.....	15	11,570
Jackson, Kalamazoo, Lenawee°.....	6	2,461	Shiawassee.....	10	1,965
Kalkaska.....	6	1,361	Tuscola.....	11	1,134
Kent.....	12	2,283	Van Buren.....	9	855
Keweenaw.....	9	1,757	Washtenaw.....	9	2,939
			Totals.....	723	531,102

°Production for adjacent counties combined to avoid disclosing output of individual mills.

August 1943.

Technical Notes No. 206

ESTIMATED LUMBER PRODUCTION 1/
1 9 4 2
MINNESOTA

Lake States Forest Experiment Station 2/
Forest Service, U. S. Department of Agriculture
In cooperation with the Bureau of the Census,
Department of Commerce and the Statistics
Division, War Production Board

Minnesota Mills Saw More Lumber in 1942

Lumber production in Minnesota in 1942 was about 18 percent more than the 1941 production according to an estimate based on the production of over 700 active mills.

Table 1.--Production of lumber, lath, and shingles, 1942

Species	Districts				State total
	North-eastern 1/	North-western 2/	Central	South-eastern 3/	
	Thousand board feet	Thousand board feet	Thousand board feet	Thousand board feet	Thousand board feet
Pine	30,465	98,044	2,875	280	131,664
Spruce	903	2,114	65	6	3,088
Balsam fir	626	1,307	67	3	2,003
Tamarack	94	1,598	318	.....	2,010
Cedar	948	1,472	1	3	2,424
Total softwoods	33,036	104,535	3,326	292	141,189
Maple	460	210	202	627	1,499
Birch	2,293	2,982	29	3	5,307
Basswood	214	3,351	1,187	1,619	6,371
Elm	15	3,468	1,486	1,368	6,337
Oak	58	3,140	596	6,182	9,976
Aspen	13,615	45,025	937	1,072	60,649
Ash	169	1,687	234	303	2,393
Miscellaneous	5	20	23	94	142
Total hardwoods	16,829	59,883	4,694	11,268	92,674
All species	49,865	164,418	8,020	11,560	233,863
Lath (M pieces)	.....	4,933	4	.....	4,937
Shingles (squares)	49	2,377	264	.....	2,690

1/ Includes Carlton, St.Louis, Lake, and Cook counties.
2/ Includes Aitkin, Crow Wing, Cass, Wadena, Becker, Norman counties and north.
3/ South of Twin Cities and east of Minnesota River.

1/ Preliminary data subject to revision. Final production statistics will be released by the Bureau of the Census.

2/ Maintained by the United States Department of Agriculture, Forest Service at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

Table 2.--Production by size of mill, 1942

Mill class	Production range	Number of mills: North east	North west	Central	South east	Total	Production (Thousand board feet): Softwood	Hardwood	Total
0	0 - 49 M	38	135	24	44	241	2,133	2,897	5,030
1	50 - 499 M	62	222	38	39	361	39,362	28,561	67,923
2	500 - 999 M	18	51	1	6	76	31,164	19,764	50,928
3	1,000 - 4,999 M	9	30	.....	1	40	58,955	31,795	90,750
4	5,000 - 9,999 M	.....	3	.....	.....	3	9,575	9,657	19,232
Idle	.....	35	102	12	19	168	.....	.....	.....
Total	.....	162	543	75	109	889	141,189	92,674	233,863

Table 3.--Production by county

County	Number active mills	Production: Thousand board feet	County	Number active mills	Production: Thousand board feet
Aitkin, Carlton°	42	11,224	Itasca	64	40,966
Becker, Ottertail°	38	7,500	Kittson	7	56
Beltrami	40	28,758	Koochiching	36	14,387
Blue Earth, LeSueur, Nicollet, Rice and Steele°	10	823	Lake	18	7,549
Cass	51	20,654	Lake of the Woods	12	1,356
Chisago	7	655	Mahnomen, Polk°	10	2,444
Clearwater	46	15,327	Morrison	14	1,711
Cook	21	7,963	Pine	10	1,223
Crow Wing	32	7,072	Roseau	22	1,838
Faribault, Freeborn, Mower, Nobles, and Olmsted°	11	1,501	St. Louis	84	32,562
Fillmore	23	2,689	Sherburne, Stearns, Todd, Benton°	6	999
Goodhue	6	1,265	Wabasha	5	1,823
Hennepin, Wright°	11	1,112	Wadena	24	5,640
Houston	22	2,690	Winona	15	712
Hubbard	23	9,627			
Isanti, Kanabec, and Mille Lacs	11	1,737	Totals	721	233,863

°Production for adjacent counties combined to avoid disclosing output of individual mills.

August 1943

ESTIMATED LUMBER PRODUCTION 1/
1 9 4 2
WISCONSIN

Lake States Forest Experiment Station 2/
Forest Service, U. S. Department of Agriculture
In cooperation with the Bureau of the Census,
Department of Commerce and the Statistics
Division, War Production Board

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Wisconsin Lumber Production Increased Slightly in 1942

Lumber production in Wisconsin in 1942 was about 2 percent more than the 1941 production, according to an estimate based on the production of over 800 active mills.

Table 1.--Production of lumber, lath, and shingles, 1942

Species	Districts			State total
	North-eastern 1/	North-western 2/	South 3/	
	Thousand board feet	Thousand board feet	Thousand board feet	Thousand board feet
Pine	22,777	22,371	8,580	53,728
Spruce	974	841	1	1,816
Balsam fir	366	75	5	446
Tamarack	321	131	589	1,041
Hemlock	76,700	55,234	122	132,056
Cedar	645	553	17	1,215
Total softwoods	101,783	79,205	9,314	190,302
Maple	73,549	15,917	8,267	97,733
Birch	26,086	21,874	853	48,813
Basswood	16,693	7,378	3,972	28,043
Elm	14,748	5,742	2,304	22,794
Beech	1,420	2	10	1,432
Oak	5,352	3,654	40,821	49,827
Aspen	15,953	18,658	3,697	38,308
Ash	3,178	2,341	307	5,826
Hickory	37	5	29	71
Sycamore	44	.....	.....	44
Walnut	2	7	47	56
Yellow poplar	412	.....	.....	412
Cherry	.....	.....	18	18
Miscellaneous	26	31	85	142
Total hardwoods	157,500	75,609	60,410	293,519
All species	259,283	154,814	69,724	483,821
Lath (M pieces)	33,603	5,169	1,636	40,408
Shingles (squares)	28,125	4,939	.....	33,064

1/Vilas, Oneida, Lincoln, Marathon, Wood, Waushara, Winnebago, Calumet, Manitowoc counties and north.
2/Iron, Price, Taylor, Clark, Eau Claire, Dunn, St. Croix counties and north.
3/Pierce, Jackson, Adams, Fond du Lac counties and south.

1/Preliminary data subject to revision. Final production statistics will be released by the Bureau of the Census.
2/Maintained by the United States Department of Agriculture, Forest Service, at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

(Over)

Table 2.--Production by size of mill, 1942

Mill class	Production range	Number of mills: North-east	Number of mills: North-west	Number of mills: South	Number of mills: Total	Production (Thousand board feet): Softwood	Production (Thousand board feet): Hardwood	Production (Thousand board feet): Total
0	0 - 49 M	95	196	81	372	2,926	4,071	6,997
1	50 - 499 M	113	148	111	372	24,109	40,533	64,642
2	500 - 999 M	28	23	20	71	12,692	35,724	48,416
3	1,000 - 4,999 M	23	11	19	53	25,727	70,399	96,126
4	5,000 - 9,999 M	4	1	1	6	18,618	21,673	40,291
5	10,000 - 14,999 M	2	2	.....	4	12,387	36,256	48,643
6	15,000 - 24,999 M	4	.....	.....	4	33,626	46,296	79,922
7	25,000 - 49,999 M	1	2	.....	3	60,217	38,567	98,784
Idle		87	101	39	227	.....	.....	.....
Total		357	484	271	1,112	190,302	293,519	483,821

Table 3.--Production by county, 1942

County	Number active mills	Production (Thousand board feet)	County	Number active mills	Production (Thousand board feet)
Adams, Juneau°.....	13	4,025	Marquette, Green Lake°	7	440
Ashland.....	21	6,065	Monroe.....	25	6,044
Barron.....	25	3,817	Oconto.....	13	14,355
Bayfield.....	36	8,185	Oneida.....	12	25,044
Brown, Kewaunee, and Manitowoc°.....	13	1,055	Outagamie.....	6	3,211
Buffalo.....	11	9,017	Pepin.....	7	2,170
Burnett.....	25	3,417	Pierce.....	8	5,531
Chippewa.....	46	6,609	Polk.....	22	3,374
Clark.....	27	3,509	Portage.....	9	3,256
Columbia.....	5	157	Price.....	31	49,619
Crawford.....	10	4,850	Racine, Milwaukee, and Walworth°.....	4	2,449
Dane, Green, Jefferson and Rock°.....	9	618	Richland.....	13	3,148
Door.....	14	1,833	Rusk.....	17	6,899
Douglas.....	22	1,591	St. Croix.....	9	559
Dunn.....	19	2,028	Sauk.....	26	6,065
Eau Claire.....	11	560	Sawyer.....	21	4,354
Florence.....	7	622	Shawano.....	32	44,924
Forest.....	21	46,978	Sheboygan, Washington and Winnebago.....	7	1,189
Grant.....	19	2,154	Taylor.....	28	37,726
Iowa.....	11	254	Trempealeau.....	18	4,994
Iron.....	12	13,942	Vernon.....	20	3,944
Jackson.....	11	8,467	Vilas.....	8	21,496
LaCrosse.....	9	4,432	Washburn.....	12	2,560
Langlade.....	13	37,264	Waupaca.....	28	4,485
Lincoln.....	9	3,686	Waushara.....	8	1,005
Marathon.....	39	16,830	Wood.....	12	17,362
Marinette.....	24	15,653	Total.....	885	483,821

°Production of adjacent counties combined to avoid disclosing output of individual mills.

August 1943

Technical Notes No. 208

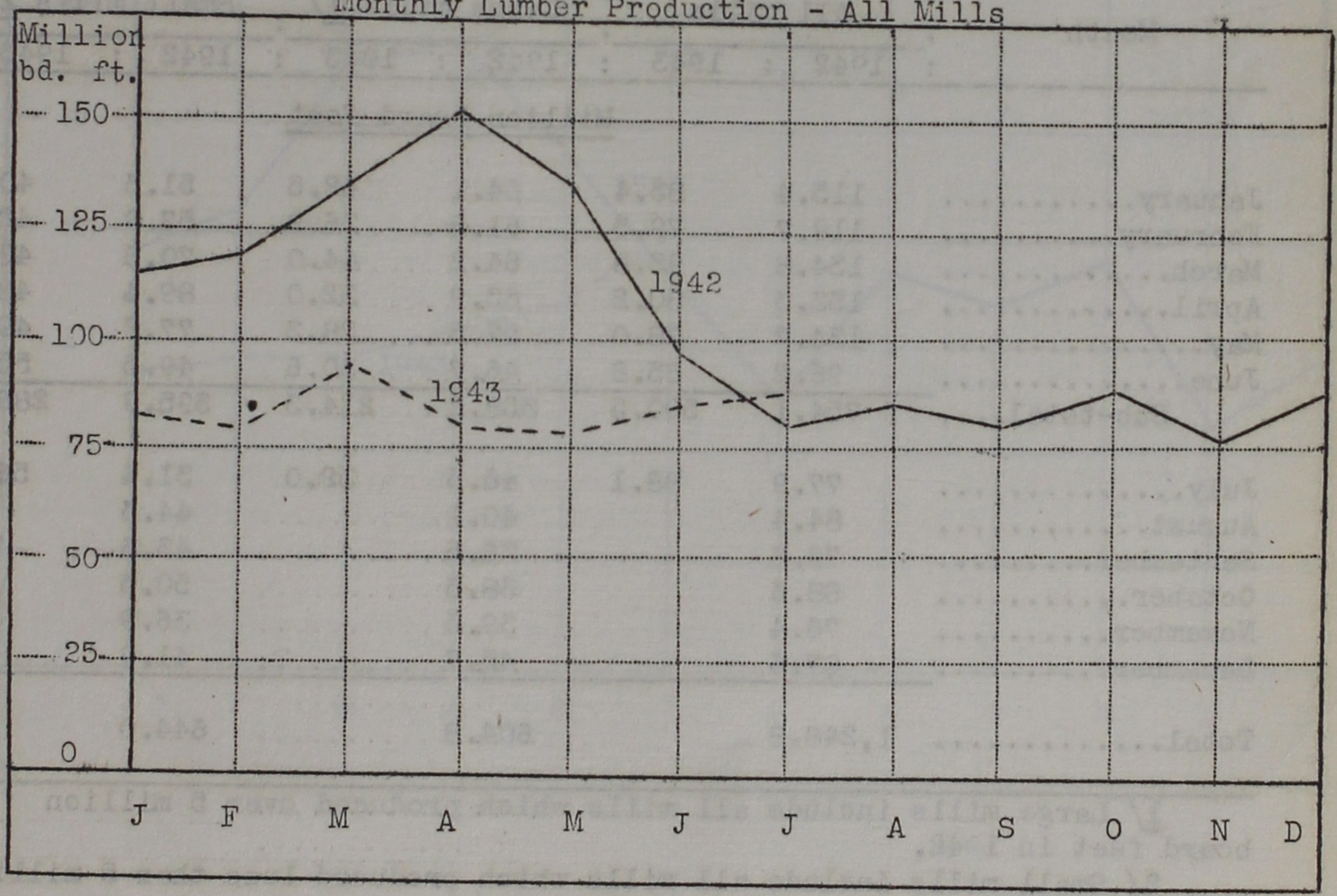
LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul 8, Minnesota

Lake States Lumber Production Off 34 Percent in 1943

Figures collected by the Lake States Forest Experiment Station for the Statistical Division of the War Production Board show that lumber production for the Lake States for the first six months of 1943 was 34 percent less than for the same period in 1942. June and July indicated an upward swing in production, and July was the first month to exceed 1942 production.

The most pronounced decrease in production was in large mills, which produced 40 percent less lumber than in the same period in 1942. Small mills were off 28 percent. Hardwood production was down 35 percent, and softwood production was down 31 percent.

Monthly Lumber Production - All Mills



August 1943

1/ Maintained by the U. S. Department of Agriculture, Forest Service at University Farm, St. Paul, Minnesota, in cooperation with the University of Minnesota.

(Over)

Hardwood and Softwood Production, by Quarterly Periods

Period	All species		Softwood		Hardwood	
	1942	1943	1942	1943	1942	1943
	Million board feet					
First quarter.....	369.9	256.5	130.2	86.6	239.7	169.9
Second quarter....	384.2	244.0	154.9	110.4	229.3	133.6
First six months..	754.1	500.5	285.1	197.0	469.0	303.5

Production of Large and Small Mills, by Month

Month	All mills		Large mills 1/		Small mills 2/	
	1942	1943	1942	1943	1942	1943
	Million board feet					
January.....	115.4	83.4	64.1	42.5	51.3	40.9
February.....	119.7	79.3	61.8	36.9	57.9	42.4
March.....	134.8	93.8	64.2	44.0	70.6	49.8
April.....	153.3	80.2	63.9	32.0	89.4	48.2
May.....	134.7	78.0	57.5	28.3	77.2	49.7
June.....	96.2	85.8	46.7	30.6	49.5	55.2
Sub-total....	754.1	500.5	358.2	214.3	395.9	286.2
July.....	77.9	88.1	46.5	32.0	31.4	56.1
August.....	84.4		40.1		44.3	
September.....	79.8		36.5		43.3	
October.....	88.6		38.3		50.3	
November.....	76.4		39.5		36.9	
December.....	87.6		45.7		41.9	
Total.....	1,248.8		604.8		644.0	

1/ Large mills include all mills which produced over 5 million board feet in 1942.

2/ Small mills include all mills which produced less than 5 million board feet in 1942.

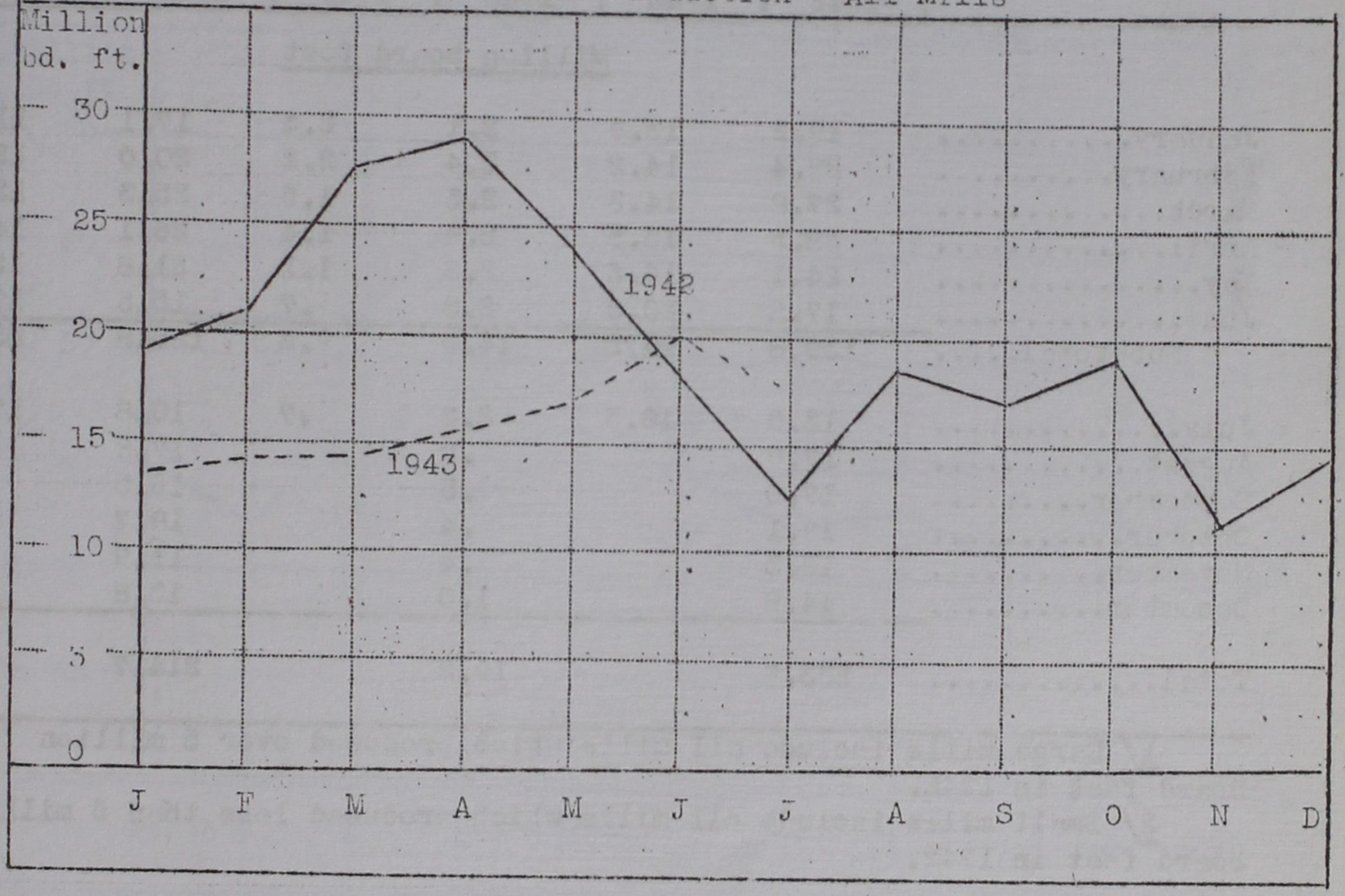
LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul 8, Minnesota

1943 Lumber Production Lagging in Minnesota

Figures collected by the Lake States Forest Experiment Station for the Statistical Division of the War Production Board indicate that lumber production in Minnesota for the first six months of 1943 was 32 percent less than for the same period of 1942. The record for June and July was more favorable.

The most pronounced decrease was in hardwood production which was off 40 percent for the six-month period. Softwood production was down 26 percent. Apparently production difficulties affected both large and small mills for production decreased about the same in both classes of mills, but were somewhat more serious for the large mills.

Monthly Lumber Production - All Mills



August 1943

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(Over)

Hardwood and Softwood Production by Quarterly Periods

Period	All species		Softwood		Hardwood	
	1942	1943	1942	1943	1942	1943
	Million board feet					
First quarter.....	69.4	42.4	39.0	25.0	30.4	17.4
Second quarter....	70.4	52.1	40.7	33.7	29.7	18.4
First six months..	139.8	94.5	79.7	58.7	60.1	35.8

Production of Large and Small Mills, by Month

Month	All mills		Large mills 1/		Small mills 2/	
	1942	1943	1942	1943	1942	1943
	Million board feet					
January.....	19.2	13.9	2.1	2.3	17.1	11.6
February.....	22.4	14.2	2.4	2.2	20.0	12.0
March.....	27.8	14.3	2.5	1.5	25.3	12.8
April.....	28.5	15.5	2.4	1.4	26.1	14.1
May.....	24.1	16.6	2.3	1.1	21.8	15.5
June.....	17.8	20.0	2.3	.7	15.5	19.3
Sub-total.....	139.8	94.5	14.0	9.2	125.8	85.3
July.....	13.0	18.3	2.2	.7	10.8	17.6
August.....	17.9		.7		17.2	
September.....	17.0		.5		16.5	
October.....	19.1		.4		18.7	
November.....	12.3		.4		11.9	
December.....	14.8		1.0		13.8	
Total.....	233.9		19.2		214.7	

1/ Large mills include all mills which produced over 5 million board feet in 1942.

2/ Small mills include all mills which produced less than 5 million board feet in 1942.

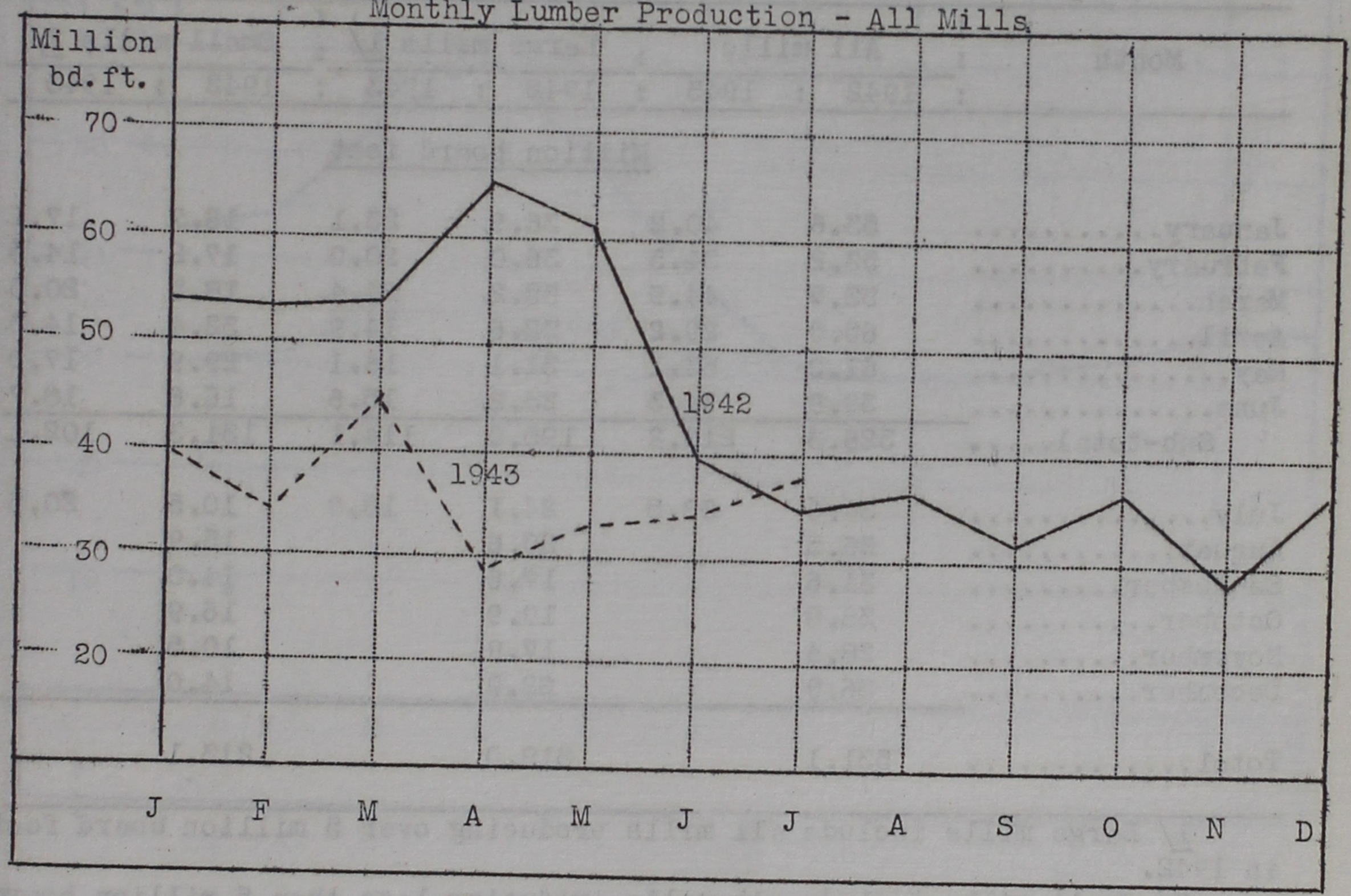
LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul 8, Minnesota

Michigan Lumber Production Declines in 1943

Figures collected by the Lake States Forest Experiment Station for the Statistical Division of the War Production Board indicate that lumber production in Michigan during the first six months of 1943 dropped off about 34 percent compared to production for the same period in 1942.

The most outstanding decrease was in large mills which produced 41 percent less lumber than last year. Small mills were off 22 percent. The production of hardwood lumber through June was off 77.7 million board feet, or 35 percent, and softwood lumber production was off 32.4 million board feet or 32 percent.

Monthly Lumber Production - All Mills



August 1943

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(Over)

Hardwood and Softwood Production, by Quarterly Periods

Period	All species		Softwood		Hardwood	
	1942	1943	1942	1943	1942	1943
	Million board feet					
First quarter.....	160.5	119.6	47.2	33.7	113.3	85.9
Second quarter....	165.8	96.6	54.6	35.7	111.2	60.9
First six months..	326.3	216.2	101.8	69.4	224.5	146.8

Production of Large and Small Mills, by Month

Month	All mills		Large mills 1/		Small mills 2/	
	1942	1943	1942	1943	1942	1943
	Million board feet					
January.....	53.6	40.2	36.9	23.1	16.7	17.1
February.....	53.2	34.5	36.0	20.0	17.2	14.5
March.....	53.7	44.9	35.2	24.4	18.5	20.5
April.....	65.0	29.2	32.6	14.9	32.4	14.3
May.....	61.0	33.1	31.1	16.1	29.9	17.0
June.....	39.8	34.3	23.2	15.6	16.6	18.7
Sub-total.....	326.3	216.2	195.0	114.1	131.3	102.1
July.....	34.6	38.5	24.1	18.0	10.5	20.5
August.....	36.5		20.6		15.9	
September.....	31.6		17.6		14.0	
October.....	36.8		19.9		16.9	
November.....	28.4		17.9		10.5	
December.....	36.9		22.9		14.0	
Total.....	531.1		318.0		213.1	

1/ Large mills include all mills producing over 5 million board feet in 1942.

2/ Small mills include all mills producing less than 5 million board feet in 1942.

Technical Notes

No. 211

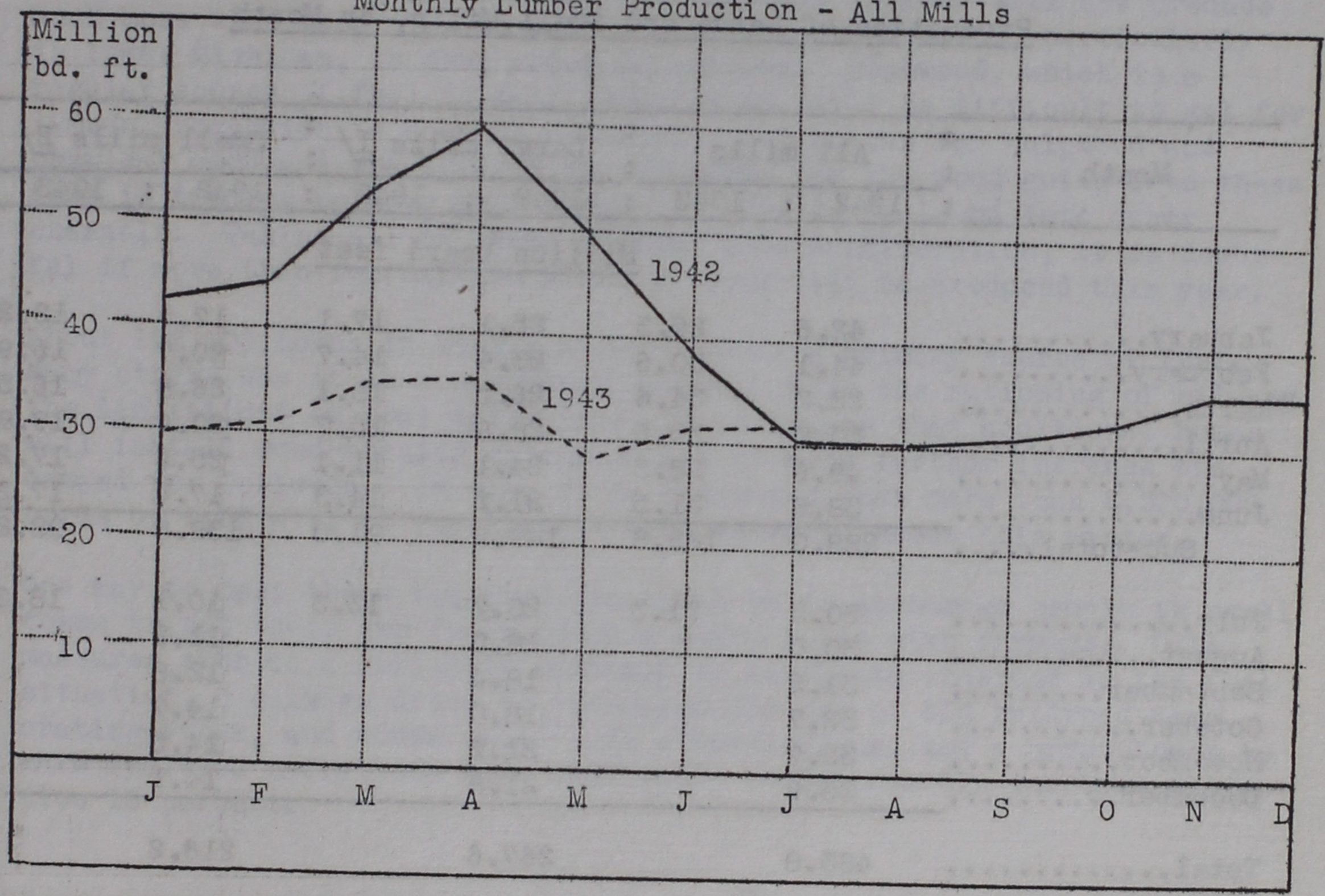
LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul 8, Minnesota

Wisconsin Sawmills Cutting Less Lumber in 1943

Figures collected by the Lake States Forest Experiment Station for the Statistical Division of the War Production Board indicate that lumber production in Wisconsin during the first six months of 1943 dropped off approximately 34 percent, compared to 1942 production.

The most pronounced decrease in production was in large mills, which produced 58.2 million feet less in this period than last year, or a decrease of 39 percent. Small mills also declined sharply, producing 29 percent less lumber. The production of hardwoods and softwoods dropped off approximately the same percent.

Monthly Lumber Production - All Mills



August 1943

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(Over)

Hardwood and Softwood Production, by Quarterly Periods

Period	All species		Softwood		Hardwood	
	1942	1943	1942	1943	1942	1943
	Million board feet					
First quarter.....	140.0	94.5	44.0	27.9	96.0	66.6
Second quarter....	148.0	95.3	59.6	41.0	88.4	54.3
First six months..	288.0	189.8	103.6	68.9	184.4	120.9

Production of Large and Small Mills, by Month

Month	All mills		Large mills 1/		Small mills 2/	
	1942	1943	1942	1943	1942	1943
	Million board feet					
January.....	42.6	29.3	25.1	17.1	17.5	12.2
February.....	44.1	30.6	23.4	14.7	20.7	15.9
March.....	53.3	34.6	26.5	18.1	26.8	16.5
April.....	59.8	35.5	28.9	15.7	30.9	19.8
May.....	49.6	28.3	24.1	11.1	25.5	17.2
June.....	38.6	31.5	21.2	14.3	17.4	17.2
Sub-total.....	288.0	189.8	149.2	91.0	138.8	98.8
July.....	30.3	31.3	20.2	13.3	10.1	18.0
August.....	30.0		18.8		11.2	
September.....	31.2		18.4		12.8	
October.....	32.7		18.0		14.7	
November.....	35.7		21.2		14.5	
December.....	35.9		21.8		14.1	
Total.....	483.8		267.6		216.2	

1/ Large mills include all mills producing over 5 million board feet in 1942.

2/ Small mills include all mills producing less than 5 million board feet in 1942.

Technical Notes

RS REFERENCE COPY

No. 212

LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul 8, Minnesota

Michigan Not Cutting Enough Fuelwood

A recent survey of the fuelwood situation in Michigan indicates that in 1943 requirements will be about 25 percent greater than production. This means a shortage of approximately 500,000 cords unless something is done to boost production. The accumulating shortage of labor for farm work and commercial operations, the pressure of high production costs against ceiling prices, the lack of interest in fuel supplies, and the difficulties of getting transportation and tools have combined to discourage fuelwood production.

Farm production of fuelwood which represents about 75 percent of the normal supply is being curtailed and probably farmers will not produce much more than they plan to use. Commercial production, particularly in lower Michigan, is down about 80 percent. Slabwood, which is a regular source of fuel in many communities, will be difficult to get for lumber production is down 34 percent. Good prices for pulpwood and chemical wood and the lowered requirements for the wood going into these uses is tending to move what normally would be fuelwood into other channels. Taking all of these factors into consideration, it is doubtful if more than two million cords of wood will be produced this year.

About 132,000 homes in Michigan use wood as a primary source of fuel. Many others use it as a secondary source. With the rationing of oil and the limitations on coal deliveries, it is likely that additional homes will install wood-burning equipment and thereby further increase the demand for fuelwood. In all, it is estimated that more than 2,500,000 cords of wood will be required to meet domestic needs this winter.

One way to meet these requirements would be to encourage people in small towns to cut their own fuelwood on a share basis with farmers. Other measures such as a publicity campaign to stimulate interest in the fuel situation, a salvage drive to encourage the use of old railroad ties, crating stock, and woods waste left after logging, and a price boost to make fuelwood operations more profitable would possibly increase production 10 percent.

September 1943

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LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul 8, Minnesota

Fuelwood Scarce in Wisconsin

Wisconsin faces a 700,000 cord shortage of fuelwood this winter unless steps are taken to increase production. Shortage of farm labor, the lack of transportation facilities, the good opportunities of making more money elsewhere, and a general apathy toward wood fuel have combined to create what may turn out to be a very critical fuelwood situation.

Over 220,000 homes in Wisconsin depend upon wood as a primary fuel, while many others use wood as a secondary fuel. With the limited supplies of oil and coal it is likely that still other homes will try to use wood as a supplementary fuel. Under normal conditions about 2½ million cords of wood are used which is 25 percent greater than the estimated production in 1943. However, if the supply of other fuels should fail the requirements for wood will be almost unlimited.

Farmers, who are by far the largest fuelwood producers, will probably take care of their own requirements, but townspeople who buy from farmers are likely to find that farmers do not have wood to sell. In many instances commercial fuelwood producers have gone out of business, particularly in the southern part of the State. Production of lumber is down 34 percent and therefore much less slabwood will be available this winter. In all it is doubtful if the total production of fuelwood will exceed 1,900,000 cords.

Practically nothing is being done to avert this shortage. One of the most promising ways to stimulate production would be to get townspeople to cut their own fuelwood on a share basis with farmers. An advertising campaign patterned after the victory garden drive might stimulate interest in the fuelwood situation. Other possibilities are to lift prices, salvage railroad ties and crating, offer special gas allotments to get to wooded areas, and to use war prisoners to overcome the labor shortage.

September 1943

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 214

Minnesota Faces Fuelwood Shortage

More than 200,000 homes in Minnesota normally use wood as a primary heating fuel and many other homes use wood as a secondary fuel. Last winter, and probably to a greater extent this winter, many homes which depend on oil and coal for heat installed small chunk burning wood stoves. A summary of all possible domestic uses indicates that not less than 2,300,000 cords of fuelwood will be needed to meet Minnesota requirements.

It is very doubtful if these requirements will be met. Production estimates indicate that production this year will be about 33 percent less than last year. Shortage of labor on farms has kept farm production to a minimum and it is doubtful if farmers will produce very much wood other than for their own use. Commercial operators have almost ceased to produce. Better margins in other forest products, high wage levels, and shortages of gasoline and equipment have encouraged these producers to shift to other work where the prospect of profits are greater and the labor requirements are less. Production by all sources in 1943 will probably be not over 1,200,000 cords or approximately one-half the amount required.

Practically nothing is being done in the State to overcome this situation. Although there is plenty of standing timber that could advantageously be cut for fuel, a major production drive is needed if this timber is to be cut. It should be possible to salvage some scrap material for fuel. Old railroad ties, old buildings, crating material and waste left after logging are sources that consumers might investigate. Public fuel yards centrally located in the smaller towns might be helpful in bringing together producers and buyers. Consumers could haul long length wood to such a central yard and use a community-owned buzz saw to cut this wood into useable lengths.

September 1943

ED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 215

Overrun of Lumber From Aspen Bolts

It is recognized that the Scribner log rule, commonly used in this region, greatly under estimates the lumber scale of small logs. Under the present closer wartime utilization, the differences are even more pronounced.

Large quantities of small aspen logs are produced throughout the Lake States. However, very little information is available in regard to actual overrun of this product at the mill. Furthermore, the conversion from a log to a mill-tally basis is made more difficult by the fact that many aspen bolts are now being sold by the cord.

In order to provide the needed information on lumber yields of aspen bolts under careful sawing, a mill-scale study was made at a portable mill in Cass Lake, Minnesota. The results of this study, showing the log scale, the actual mill tally based on 1,286 trees, and the percentage overrun, are presented below.

Log scale and mill-tally scale of sound aspen bolts

Scale per 8-foot bolt				Scale per standard cord 1/			
Top d.i.b. of bolts	Log scale Scribner Dec. C rule	Mill-tally 2/	Over-run	Ave. top d.i.b. of bolts	Ave. Log scale Scribner rule	Mill-tally 2/	Ave. overrun
Inches	Bd.ft.	Bd.ft.	Pct.	Inches	Bd.ft.	Bd.ft.	Pct.
6	5	12	140	6	210	504	140
7	10	16	60	7	275	508	85
8	10	21	110	8	330	521	58
9	20	27	35	9	370	538	45
10	30	35	17	10	402	554	38
11	30	44	46	11	428	565	32
12	40	52	30	12	452	572	27

1/ 4 x 4 x 8 feet.
2/ Rough lumber, varying from 1 to 2 inches in thickness and 3 to 10 inches in width.

April 1944

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LAKE STATES FOREST EXPERIMENT STATION
University Farm, St. Paul 8, Minnesota 1/

A New Trend in Small Sawmill Operation

A significant trend, brought about largely by wartime conditions, that has been observed recently among the smaller sawmills in the Lake States is the combining of lumber production with the manufacture of secondary products. The tendency is particularly evident in lower Michigan. Since the combining of primary and secondary processing means closer utilization of woods and mill waste, it is hoped that it may be continued after the war. It also can help to make better forest practices pay and give employment to people in rural areas.

One sawmill operator, for instance, is making parts for farm implements, such as hayracks, tool handles, and wagon bodies. Another sawmill has installed an automatic lathe to make wood turnings, while others are manufacturing such items as factory truck platforms, door mats, onion and celery crates, railroad and mine wedges, and seed germination flats. Two small mills are reworking industrial blocking, cutting it to final size, boring holes at proper spacing, and shaping for blocking railroad shipments of heavy machinery.

Although low-grade lumber temporarily is in big demand, there is no question that sawmill operators will again be faced with the problem of finding a market for the lower grades when the present heavy wartime demand terminates. By cutting up this material and fabricating it, some of the difficulties of marketing low-grade lumber can be overcome.

April 1944

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LAKE STATES FOREST EXPERIMENT STATION
University Farm, St. Paul 8, Minnesota 1/

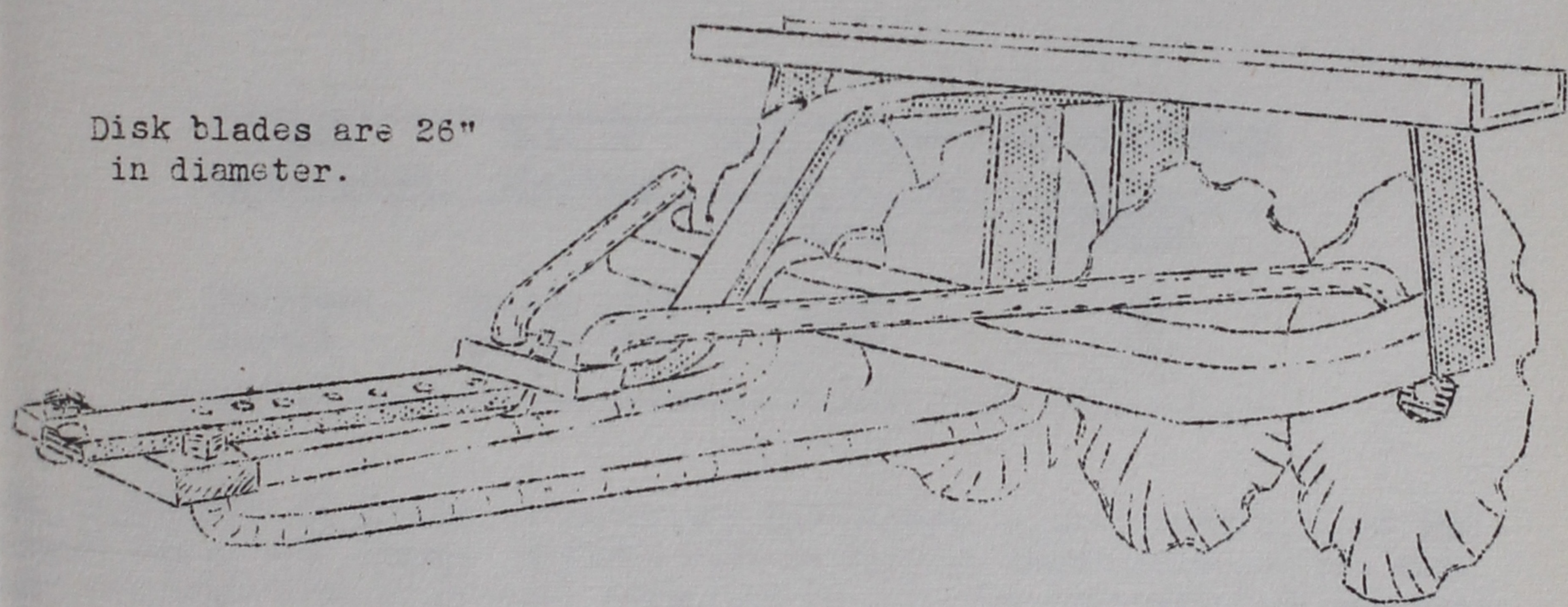
Disking Reduces Slash Fire Hazard in the Jack Pine Type

The Athens type disk, an adaptation of the agricultural disk harrow, has come into considerable use on national forests in the Lake States for scarifying the soil to assist in regeneration of jack pine following logging. This practice also lowers the logging slash fire hazard to about the same degree as that accomplished by piling and burning.

The disk, which weighs about 1,400 pounds, is pulled with a 35 h.p. crawler-type tractor. The disk-tractor unit is sufficiently powerful and heavy to break through the slash and expose 25 to 40 percent of the mineral soil. This contributes substantially to the reduction of the initial fire hazard. In addition, a considerable amount of the slash is buried and the remainder is broken and flattened close to the ground where decay progresses rapidly.

The cost, including supervision and depreciation on the machinery, ranges from $4.25 to $5.75 per acre, based on an operating speed of about 2 hours per acre.

Although disking as a fire protection measure was incidental to preparing the ground for natural or artificial regeneration, it may be adopted as an independent operation to take the place of piling and burning where the fire hazard warrants special slash disposal methods.



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University Farm, St. Paul 8, Minnesota 1/

Disking Saves the Topsoil in Forest Planting

Deforested areas in the Lake States usually are prepared for tree planting by plowing furrows with a double mouldboard plow that deposits the sod and upper layer of soil in ridges on either side of a rather broad furrow. Although the furrows materially increase the ease of planting, reduce plant competition, and increase survival for the newly planted trees, compared to planting in scalped spots, two rather serious objections have been raised:

(1) The fertile topsoil is displaced, leaving only the sterile subsoil of poorer texture in which to plant the trees.

(2) The alternate furrows and ridges hinder travel, either on foot or by car. Hunters, particularly, have been annoyed by the difficult walking conditions created by reforestation plowing.

Preliminary tests of planting on disked soil indicate that disking may be one way of avoiding the problems created by plowing. The Athens-type disk harrow effectively destroys competing vegetation and mixes and loosens the soil, but it neither throws the topsoil to the sides nor does it create the objectionable furrows and ridges. Some measurements of the growth of 2-2 red pine planted both in disked and furrowed areas about 200 acres in extent on the Chippewa National Forest are shown below:

Soil preparation	Date of planting	Ave. height after 2 yrs.	Survival after 2 yrs.
		Feet	Percent
Furrowed	Spring 1940	0.80	89
Disked	Spring 1940	1.24	96

The difference in growth reflects the difference in soil fertility of the disked and plowed areas. Methods such as disking which preserve the topsoil are deserving of greater attention in post-war reforestation programs.

April 1944

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 219

Northern Hardwoods Can Be Cut Selectively at Short Intervals

The first experimental cutting in northern hardwoods on the Upper Peninsula Experimental Forest, Dukes, Michigan, indicates that a light selective cut may be made at short intervals under management.

Approximately 19 acres of old-growth northern hardwoods were cut selectively in 1926, and again in 1943. The net growth in 17 years, between 1926 and 1943, amounted to 3,196 board feet per acre.

	Net volume per acre (Scribner) Ft., B.M.
Original stand, 1926	9,210
Cut, 1926	1/ 2,344
Left, 1926	6,866
Growth, 1926 to 1943 (17 years) . . .	3,196
Stand before cutting, 1943	10,062
Cut, 1943	2/ 1,583
Left, 1943	8,479
Growth per year	188

1/ Plus 13 cords of chemical wood.
2/ Plus 5.2 cords of chemical wood.

Experience on the Experimental Forest has demonstrated that cuts as low as 1,500 board feet per acre find ready sale among the farmer-logger types of operators. However, with 188 board feet of growth per acre per year, the intervals at which timber should be cut can be adjusted to the special requirements of management.

April 1944

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LAKE STATES FOREST EXPERIMENT STATION
University Farm, St. Paul 8, Minnesota 1/

Additional Volume of Spruce Pulpwood Gained by Utilizing To A 1½-Inch Top

Black spruce pulpwood ordinarily is utilized in the Lake States to a diameter of about 3½ inches. Since most merchantable trees range in diameter at breast height from 6 to 9 inches, it is readily apparent that the unused portions above the 3½ inch limit constitute an appreciable part of the total volume. The waste is, of course, proportionately greater on small trees than on larger ones.

The percentage increases that can be obtained from the tops of representative size black spruce trees are shown below:

D.B.H.	Height	Gain in volume by cutting to 1½ inch instead of 3½ inch top
Inches	Feet	Percent
4	36	178
5	42	41
6	48	22
7	53	8
8	58	13
9	62	8
10	64	6
11	67	5
12	68	5

The net effect of utilizing black spruce to a 1½ inch top is a gain in volume of about 22 percent under clear cutting and about 10 percent under partial cutting where principally larger trees are cut. This was determined in field trials conducted by the Minnesota and Ontario Paper Company in cooperation with the Minnesota Department of Conservation and the Experiment Station.

The figures indicate merely the gain in volume by cutting to a 1½ inch top instead of a 3½ inch top. How practical such a change will be depends on the utilization of the small top bolts, which contain less solid wood per cord and from which it is difficult to remove the bark. However, if the small top bolts are used for the manufacture of insulating material where the bark does not need to be removed, such a change in method of cutting may be a real improvement.

April 1944

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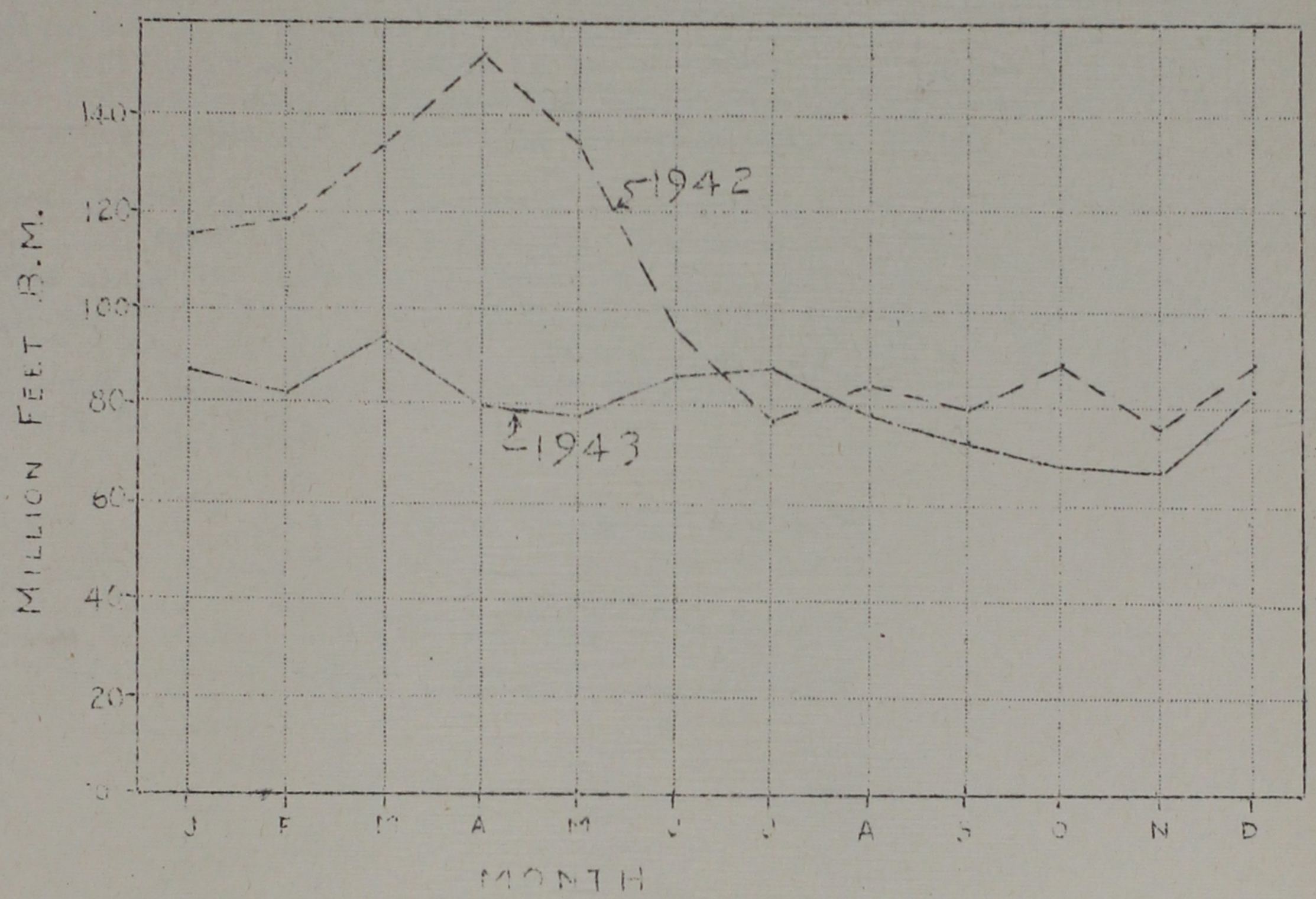
LAKE STATES FOREST EXPERIMENT STATION
University Farm, St. Paul 8, Minnesota 1/

Elimination of Seasonal Variation in Lumber Production - A Hopeful Trend

A change that occurred in lumber manufacture in the Lake States during 1943 was the leveling-out of monthly lumber production. Instead of having high and low periods of production, the tendency was to operate more on an even keel throughout the entire year. In place of the usual big drop at the end of the winter logging season, production continued at about the same level during the summer.



This leveling-out process in 1943 largely can be accounted for by the shortage of manpower. In order to supply the strong demand for lumber with limited crews, the workers were kept continuously employed throughout the year.

Whether the practice will continue, when labor again becomes plentiful, is not certain, but continuous all-year employment eliminates the seasonal disadvantages of working in lumber camps; it helps to develop skilled crews and that means greater efficiency and higher quality production.

April 1944

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University Farm, St. Paul 8, Minnesota 1/

Does Diameter Growth Response Hold Above D.B.H.

One of the advantages of selective logging is that the remaining trees show, as a rule, an accelerated rate of growth. Since this growth is measured at diameter breast height, there is a question whether this growth is concentrated near the base of the tree or is distributed proportionately along the entire stem.

A second logging-over in 1943 of a tract of northern hardwoods previously cut in 1926 presented an opportunity to answer this question. If the growth is deposited uniformly in proportion to the diameter along the stem, then the taper of the trees should not show any change as a result of the cut in 1926. This is exactly what has happened as the measurements showed.

Some 70 trees, ranging in size from 8 to 25 inches d.b.h., were studied after they had been felled and cut into logs. Measurements were collected on growth at points along the stem from 2 feet to 33 feet above the ground. From these observations the ratios of the growth at the various heights above ground to growth at d.b.h. were determined. These ratios were very similar for trees of all sizes. As an illustration, the table of ratios for 15 inch diameter-class trees is shown below:

Height above ground (feet)	Ratio of radial growth at different heights to growth at d.b.h.	
	17 yrs. before cutting	17 yrs. after cutting
2	1.09	1.10
4.5	1.00	1.00
9	.89	.90
17	.84	.84
25	.79	.80
33	.77	.78

It may be seen that following light selective cutting the forms of the trees did not change and diameter growth response held at points above d.b.h., at least to the end of the second standard log. Thus, growth calculations based on periodic d.b.h. measurements and the application of volume tables will give true pictures of growth.

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LAKE STATES FOREST EXPERIMENT STATION
University Farm, St. Paul 8, Minnesota 1/

Gasoline Requirements of Small Sawmills

A recent survey among sawmill operators in the Lake States revealed that the average gasoline consumption of small sawmills is approximately 5½ gallons per 1,000 board feet of rough lumber. The requirements of individual mills, however, varied widely; some consumed as little as 3 gallons and others as much as 8 gallons per 1,000 board feet.

No doubt much of the variation in efficiency reflected differences in the size, type, and working condition of the power units and mills, but the following factors also have a considerable influence on gasoline requirements:

1. Full crew and continuous operation.--Mills that operate steadily with sufficient manpower use less power per 1,000 feet of lumber.

2. Kind of timber.--Generally the heavier and harder kinds of wood require more than average power.

3. Season.--Frozen wood required substantially more power to saw than unfrozen wood.

4. Quality of products.--Production of higher grade lumber reduces the speed of the operation.

5. Size of timber.--Small logs are less efficient to saw than larger ones.

Gasoline is a relatively small item in the cost of producing lumber, but it offers some possibilities for savings to operators who are using more than average quantities. In many instances it is probable that a check into the cause for abnormally high gasoline consumption also would bring out other opportunities for increasing the overall efficiency of the saw-milling operation.

Under present conditions, when conservation of gasoline and more effective use of manpower are vital necessities, it is the responsibility of lumber producers to operate just as efficiently as possible.

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LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul 8, Minnesota

Save Shelterbelts and You Save Fuel

There is a possibility that shortages of coal during the coming winter or later may induce farmers to cut trees which protect their homes from winter winds. By cutting off these shelterbelts, the farmer may effect no economy at all as the fuel needed to heat the exposed buildings will increase.

Wind plays an important part in the heating of a house. An average good windbreak in the northern plains region may save up to 25 percent on the fuel consumption during the winter if situated north of a house with average type of construction and insulation. This was not only the consensus of opinion of a large number of farmers individually consulted in South Dakota. It has also been verified by tests made by the Lake States Forest Experiment Station with test houses. Of course, the tree belt must be reasonably close to the house to give the greatest benefits.

When the house is located in a corner or near the junction of two shelterbelts which give protection from both north and west winds, a fuel saving of from 32 to 34 percent can be expected. The house located in a grove with protection from all winter winds can expect fuel savings up to 42 percent. Naturally some protection is also given the house by other buildings. In all cases, it is desirable to obtain just as much wind protection as possible for the house in which artificial heat is used.

Winds affect the heating of a house and likewise speed the cooling of the barn and other buildings housing livestock. As a means of conserving fuel even the poorest windbreak is of some good, and great care must be exercised to maintain this protection. In the managed woodlot, dead and mature trees can be harvested. When the grove is small only the dead trees at the most should be removed, and even these are not without merit in maintaining a windbreak, since most of the shelterbelts are leafless anyway in winter.

August 1944

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LAKE STATES FOREST EXPERIMENT STATION 1/
University Farm, St. Paul 8, Minnesota

Quick Field-Calculator of Volume and Growth of Trees

The Station has devised a quick and simple method of computing volume and growth of trees in the field. The device is in the nature of a slide rule, 8 inches long and 1 inch wide. The face of the rule has two graduations, the upper one showing volume in board feet, Scribner, and the lower one showing the volume increment per inch of the diameter growth. The movable slide shows the D.B.H. from 10 to 40 inches. The reverse side can be used for obtaining the growth percent. The rule is founded on the composite volume table previously developed by the Station and applies to both hardwoods and softwoods, provided that the log-height is estimated to a point on the stem not less than 8 inches inside the bark. The workings of the slide rule are explained by the following figures:

Suppose it is desired to determine quickly the volume of a tree which has two 16-foot logs and is 18 inches in diameter breast high. To obtain the volume in board feet (figure 1), set the arrow shown on the slide (A) opposite the 2-log mark (shown on the upper "number of logs" scale of the rule). The volume will be found on the same scale opposite the figure 18 on the slide, indicating the diameter breast high. The answer is 207 board feet.

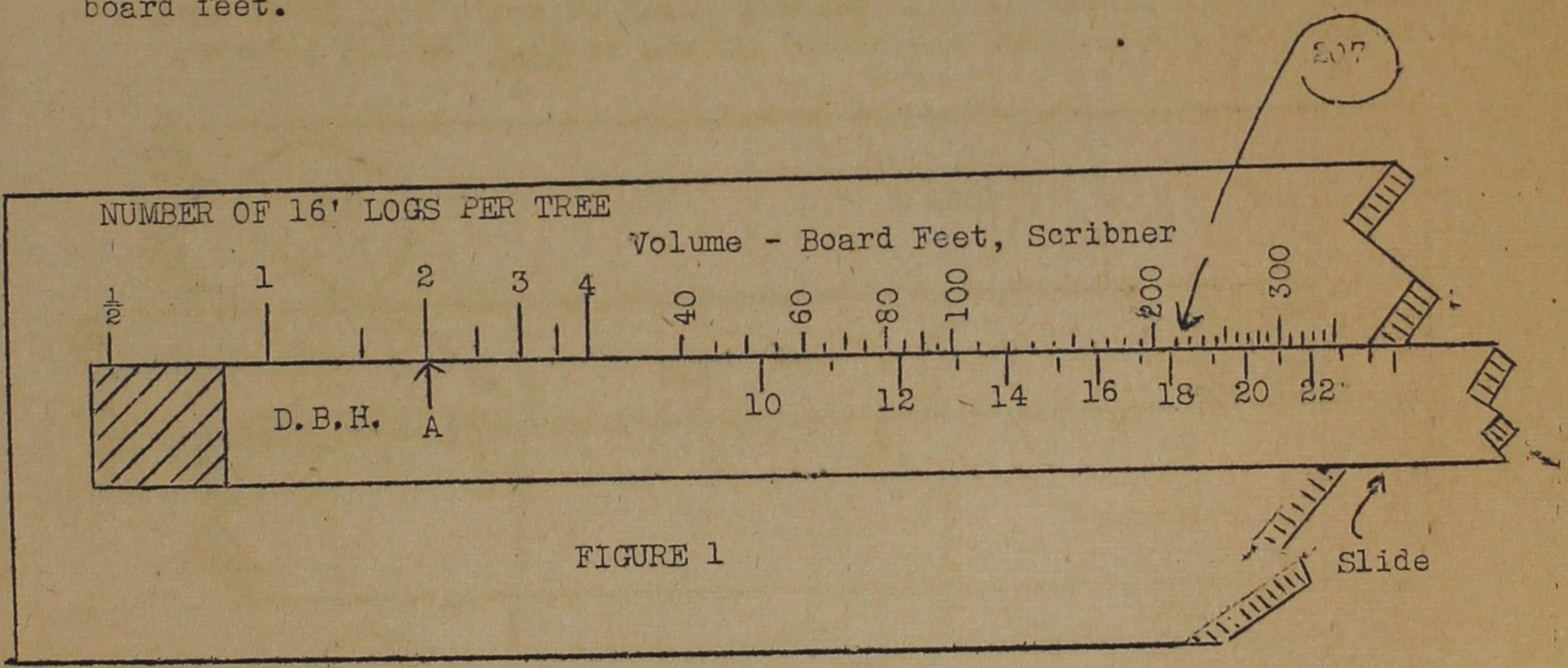

FIGURE 1

August 1944

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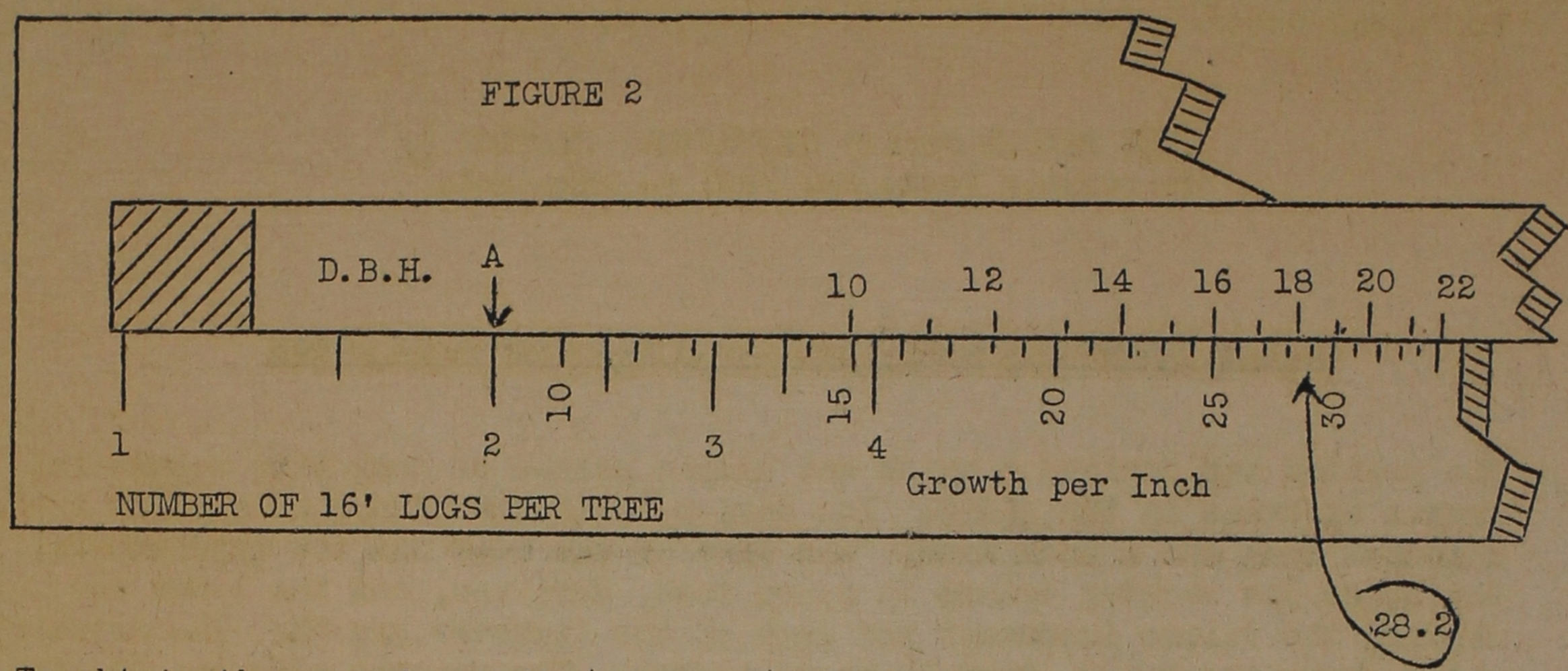
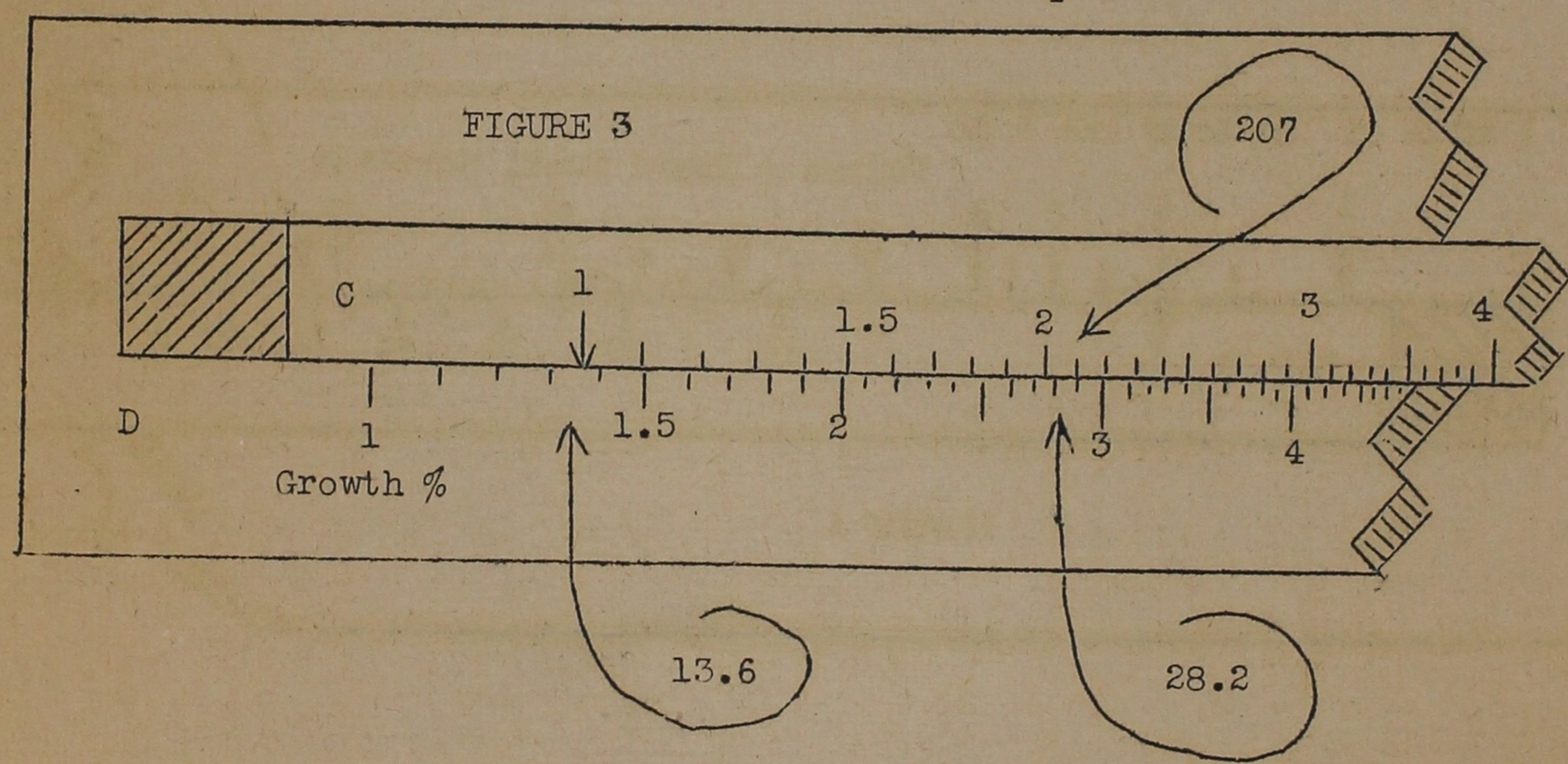


To obtain the annual growth (figure 2) of the same tree, set the arrow (A) opposite the 2-log mark, but this time on the lower "number of logs" scale. The volume increment is read on the "growth per inch" scale opposite the 18-inch mark (the tree diameter at breast height) of the slide. The answer is 28.2 board feet, Scribner scale. To get the annual growth, it is necessary to divide 28.2 by the number of years which it took to grow 1 inch in diameter. If it took 4 years to grow 1 inch, the annual growth will be $\frac{28.2}{4}$ = 7.05 board feet.

If it is desired to obtain the growth percent, use the reverse side of the rule. To get the growth percent (figure 3) the tree volume 207 (2.07 on the slide scale C) is set opposite the volume growth, or 28.2 (2.82 on scale D) and opposite 1 on the slide scale C, the growth percent is read on scale D. The answer is 13.6 percent (1.36 on scale D). If it took 4 years to grow 1 inch, then the annual growth is $\frac{13.6}{4}$ or 3.4 percent.



Thus, by three simple manipulations of the slide, after the log-height, the d.b.h. and the diameter increment are known, the volume, growth and growth percent can be determined right on the spot within a few seconds.

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION

U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE

UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 226

Nutrients in Duff and Humus Layers Increase Growth of Forest Plantations

It has been noted that trees planted on disked or turned soils get off to a quicker start than trees planted in furrows. Experiments with red pine and black spruce showed 50 percent greater height growth at the end of two and three years after planting on disked areas or on turned under soil than in furrows. The usual technique of planting trees in the bottom of a furrow results in placing them in a more sterile part of the soil, because the nutrient laden surface layers are thrown to the side by the plow and do not immediately benefit the trees. On many sites, planting can be done advantageously in disked areas or on top of turned under top soil. In others, the reduction of competition by furrowing or broadcast burning may be more important as a factor in improving moisture relations and hence survival.

A chemical analysis of the surface layers of soil on five different aspen stands in Wisconsin is given below as an indicator of the nutrient values in the organic portions of the podsolic soils.

Soil characteristics	Soil horizon				Ratio of value to that in A_2 layer			
	1/ Duff	2/ Humus	A_1	A_2	Duff	Humus	A_1	A_2
Ave. thickness of layer (inches)	0.55	0.65	1.2	3.4	..	..	..	..
Organic matter (percent)	50.2	26.4	7.5	1.1	46	24	7	1
Total nitrogen (percent)	0.938	0.529	0.216	0.035	27	15	6	1
Replaceable calcium 3/	27.1	21.8	7.5	1.37	20	16	5	1
Base exchange capacity 3/	52.2	44.4	16.9	5.9	9	7	3	1
Available potash 4/	1240	790	73	54	23	15	1	1
Available phosphorus 4/	161	105	23	34	5	3	1	1

1/ Partially decomposed leaves. 2/ Black layer of humus below the duff.
2/ Milliequivalents per 100 grams. 4/ Parts per million.

Of particular interest is that part of the above table which shows the ratios of the values for the organic portions of the soil profile and the black humus rich A_1 soil layer just below, to the gray leached-out A_2 layer. When there is 46 and 24 times as much organic matter in the duff and humus, respectively, as in the A_2 layer, can we afford to use ground preparation methods like furrowing which rob the planted trees of these nutrients for a considerable period?

January 1945 Joseph H. Stoeckeler, Silviculturist

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 227

Oak Is The Favorite Tie Species In Southern Wisconsin

Under the stress of wartime demands, railroad cross ties have been made from a variety of tree species, including such usually unacceptable ones as river birch, soft maple, American and red elm, and aspen. However, as a general rule, the principal tie trees of southern Wisconsin continue to be red and white oak. Miscellaneous oaks (bur, pin, and black), sugar maple, white, green, and black ash, black cherry, bitter nut, pignut, and shag-bark hickory, and occasionally black walnut and tamarack are used for ties, but the aggregate volume of these species is insignificant as compared to red and white oak.

The following examples show how oak predominates in the output of three major tie-producing concerns in southern Wisconsin:

Species	Concern A (1941 production)		Concern B (1943 production)		Concern C (1944 production)	
	Number	Percent	Number	Percent	Number	Percent
Red oak	94,652	95.4	13,502	82.8	9,670	67.9
White oak	4,536	4.6	1,208	7.4	1,716	12.1
Sugar maple	.....	....	1,538	9.4	.....	....
Soft maple	.....	....	.....	....	2,556	18.0
Red elm	.....	....	56	0.4	.....	....
River birch	.....	....	.....	....	290	2.0
Total	99,188	100.0	16,304	100.0	14,232	100.0

The high rating which most railroads give to oak ties and the rather large volume of mature oak available which appears to be more suitable for ties than anything else indicates that the manufacturing of cross ties and switch ties will continue to occupy a place of high importance in the woodlots of southern Wisconsin.

January 1945

Harold F. Scholz, Silviculturist

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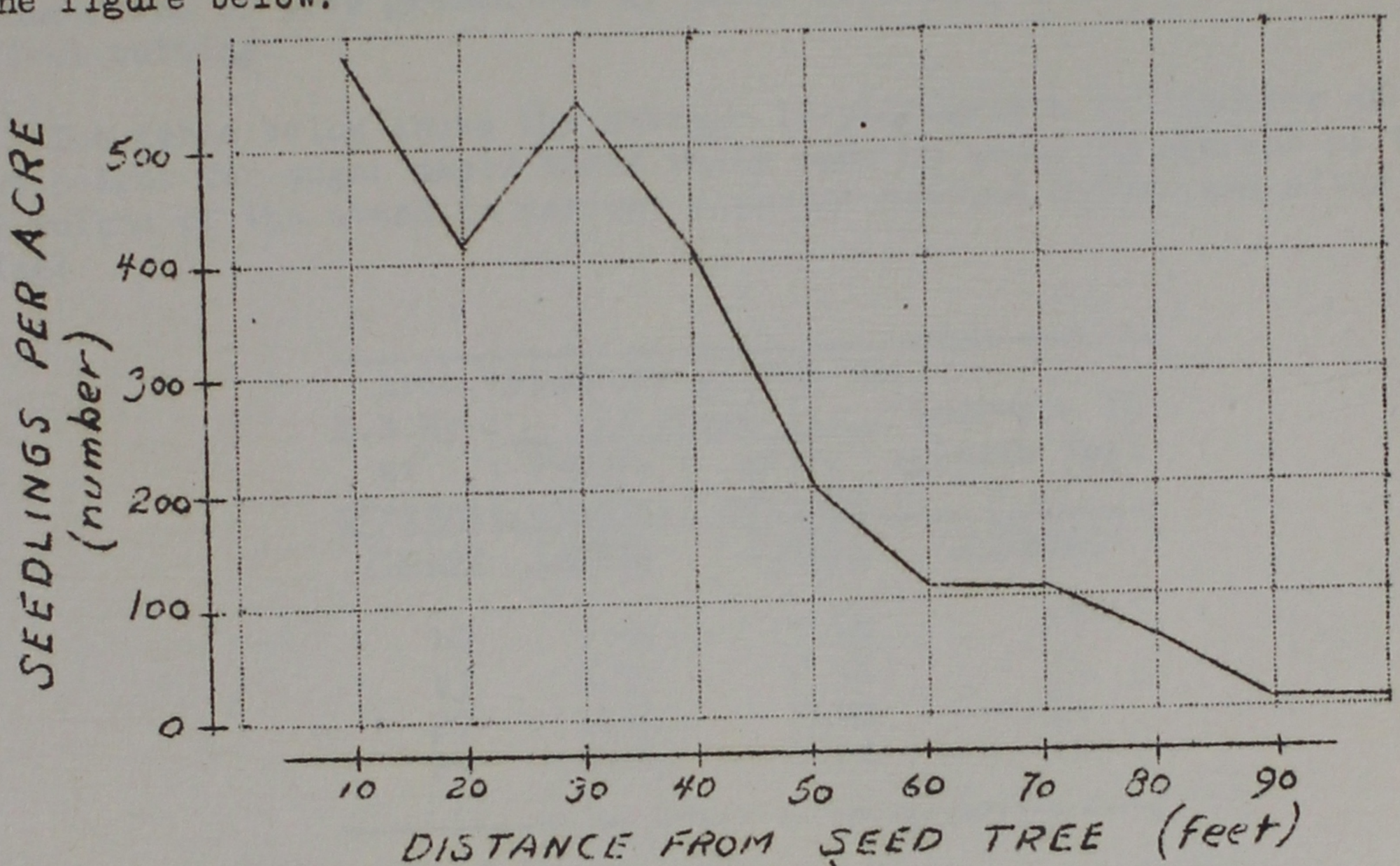
TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 228

Effective Seeding Range of Red Pine

From 1904 to 1923 the red pine stands on the Chippewa National Forest in Minnesota were cut under a seed tree method which specified the leaving, at first of five percent and later 10 percent of the volume in the form of seed trees.

A survey was recently made to determine the effective seed dispersal range of the seed trees and thus the number needed per acre to obtain full restocking. Seedlings which were found by ring count to have become established following logging (which incidentally made up less than one-third of the reproduction present) were recorded by distance from the seed trees. The essential information is shown in the figure below:



(Basis: 1,195 mil-acre plots.)

It was found that the effectiveness of the seed trees decreased rapidly beyond 40 feet. Assuming 1,200 seedlings per acre as full stocking, the average stocking even within this distance is but 41 percent. For full stocking the spacing of the seed trees would have to be 60-80 feet, or 20-30 seed trees per acre, in mature stands with full seed producing capacity. In young stands this number would have to be increased in proportion to the lesser seed producing ability of the younger trees.

January 1945

Paul J. Zehngraff, Silviculturist

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 229

Growth Response in Sugar Maple Following Light Selective Cutting

A study of growth in sugar maple following light partial cutting at the Station's Upper Peninsula Branch has disclosed an acceleration of about 15 percent due to the cutting. The study area was first cut selectively in the fall of 1926, about one-third of the gross volume of overmature northern hardwoods being removed. A second cutting in the fall of 1943 made possible the comparison of tree growth for 17 years preceding and 17 years following the first cutting.

The table below shows the average 17-year-growth in diameter at breast height for sugar maple trees, which made up about 70 percent of the total volume of the stand, in various diameter classes before and after cutting:

Ave. D.B.H. at present	Diameter growth in: 17 years 1/ Before cutting	After cutting	Increase in growth rate
Inches	Inches	Inches	Percent
10	1.40	1.78	27
15	1.93	2.21	15
20	2.06	2.28	11
25	2.06	2.28	11

1/ Basis 70 trees.

The rate of diameter growth increased gradually from trees 10 inches d.b.h. to trees 18 inches d.b.h., both before and after cutting. Above 18 inches d.b.h. the rate was almost constant.

Walter M. Zillgitt, Silviculturist

January 1945

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 230

Selective Logging Yields Higher Grade Lumber

A 6½ million foot northern hardwood timber operation in the western part of the Upper Peninsula of Michigan, one-fourth of which was logged by selective methods and three-fourths by clear-cuttings, offers interesting comparisons in grade yield of sawed lumber. The logs cut selectively were larger on the average and produced more of the higher grades of lumber. The grades of sugar maple lumber recovered in the two types of cutting are shown below. Sugar maple made up the bulk of the cut.

Lumber grade	Price per M (6/4")	Actual recovery of lumber by grades per M ft., b.m.	
	Dollars	Amount Percent	Value Dollars
Selective Cutting			
FAS	117.50	12.3	14.45
Select	99.00	11.0	10.89
No. 1	77.00	18.3	14.09
No. 2	55.00	17.7	9.74
No. 3(a)	39.00	16.4	6.40
No. 3(b)	32.00	24.3	7.78
Total		100.0	63.35
Clear Cutting			
FAS	117.50	8.0	9.40
Select	99.00	8.1	8.02
No. 1	77.00	18.1	13.94
No. 2	55.00	19.5	10.73
No. 3(a)	39.00	19.7	7.68
No. 3(b)	32.00	26.6	8.51
Total		100.0	58.28

Operators who are feeling the pinch caused by rising production costs and fixed selling prices may find a partial solution to this problem through selective cutting.

January 1945

Waldo M. Sands, Forest Economist

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TECHNICAL NOTES

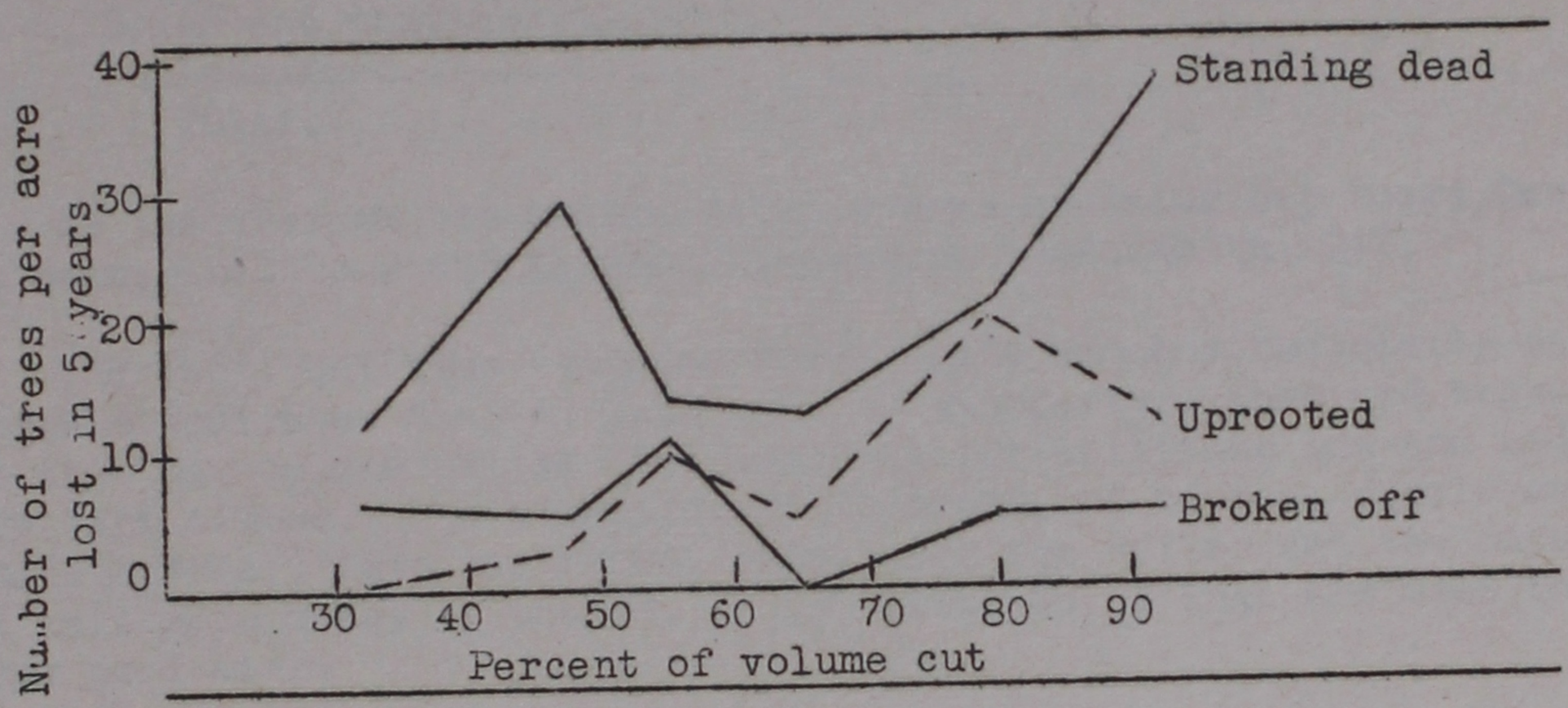
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 8, MINNESOTA

No. 231

What Causes Mortality in Black Spruce After Partial Cutting?

That uprooting has been greatly overrated as a cause of mortality following cutting in black spruce swamp forests, is disclosed by a study recently completed in Minnesota. Only 24 percent of the deaths during the five years after partial cutting could be attributed to uprooting. Another 12 percent of the deaths resulted from breakage, which may be caused by logging injury, heartrot, glaze, or wet snow, as well as wind. The remaining 64 percent of the dead trees were still standing and had died from such causes as extended suppression, exposure following logging, insects, mistletoe, disease, and mechanical injuries.

Uprooting increased with severity of cutting, but in nearly all cases it was decidedly of secondary importance.



Black spruce growing on peat soils evidently has greater ability to resist wind action than is commonly supposed. On mineral soils, however, black spruce is more likely to uproot. The greater windfirmness on peat probably is due to the resilience of peat which permits the roots considerable motion without actually tearing loose.

April 1945

Russell K. LeBarron, Silviculturist

Maintained by U. S. Department of Agriculture in cooperation with the University of Minnesota

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 232

Tie Production Important in Southwestern Wisconsin

Railroad cross ties made up a greater volume than any other sawed timber item produced by sawmills in southern Wisconsin, according to a recent Forest Service survey. In 1942 slightly less than 70 million board feet of material was manufactured by some 200 sawmills located in this part of the State. The principal items sawed included:

Railroad ties.....	24 million board feet
Lumber and dimension stock.....	22 " " "
Miscellaneous custom work for farmers.....	13 " " "
Boxes and containers.....	9 " " "
Unclassified.....	2 " " "
Total.....	70 " " "

As the average tie milled in this area contains 34½ board feet, this means that some 695 thousand ties were produced in 1942.

The fact that ties occupied first place among commercially-sawed materials indicates that it pays well to manufacture them and suggests that this may be one of the best products for utilizing low and medium grade farm timber. The highest quality trees, of course, should not be made entirely into tie bolts, since both the seller and the buyer will make more money if the No. 1 and better No. 2 logs are used for veneer or lumber.

April 1945

Harold F. Scholz, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 233

Brush Shade Increases Plantation Survival on Droughty Sites

That brush shade may increase survival considerably is brought out by tests made in plantations of ponderosa pine, Scotch pine, and juniper in McHenry County, North Dakota.

Planting was done in the spring of 1941 on a well stabilized, mostly south and west facing, sand dune covered by a sparse growth of blowout grass and sand reed grass. The ratio of soil surface temperature to air temperature in the shade on this site is generally in the range of 1.48:1 up to 1.66:1, and soil surface temperatures often reach 140° to 160°F. on summer days. These high temperatures combined with a low annual rainfall of only 15 inches makes this a very difficult planting chance.

About 900 trees of each of eight age-classes and species were planted in spots where the grass had been scalped off in 16-inch squares. Shortly after planting, about half a dozen small branches of chokecherry and dry brush from 1/4-inch to 3/4-inch in diameter and 2 feet long, were placed over each planted tree in half of the scalps, mostly on the south side and straddling the scalp. Half of the trees were left unshaded. Results of the tests after four years are shown below:

Age class	Species	Fourth year survival	
		Brush shade	No shade
		Percent	Percent
2-0	Ponderosa pine	46	25
2-1	" "	82	77
2-2	" "	52	42
2-0	Rocky Mountain red cedar	95	66
2-1	" " " "	91	77
2-2	" " " "	51	34
2-2	Scotch pine	36	21

Benefits of brush shading are threefold: (1) Soil surface temperature is lowered; (2) transpiration is reduced; and (3) eventually a very small amount of organic matter is added to the nearly sterile soil. As indicated in the table above, the smaller age-classes seem to benefit most by brush shading, especially the seedling grades. Also of interest is the fact that on this site when no shade was used well balanced 2-1 stock of the two main species gave better survival than seedlings or the more top-heavy 2-2 transplants.

April 1945

Joseph H. Stoeckeler, Silviculturist

Maintained by U. S. Department of Agriculture in cooperation with the University of Minnesota

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 8, MINNESOTA

No. 234

Young Growth Little Damaged in Selective Logging of Northern Hardwoods

Will a second selective logging of old-growth northern hardwoods wreck the young trees that have developed since the first cutting? A second cutting of a 19-acre tract on the Upper Peninsula Experimental Forest 17 years after the first operation throws light on this question. In the second operation 1,583 board feet of logs and 5.2 cords of chemical wood per acre (about 16 percent of the total volume) were removed. Loggers were cautioned to avoid any undue damage to small trees. The loss of advance reproduction (trees 2" to 10" d.b.h.) by causes, as shown by a 4-acre sample, is summarized in the following table:

Cause of loss	Trees (2" to 10" d.b.h.) lost per acre	
	Number	Percent
Felling.....	12	5
Skidding and decking.....	10	4
Total.....	22	9

In addition, four trees per acre of this size class, or 2 percent, were damaged by logging, but not beyond recovery.

Most trees destroyed were small, not over 3 inches d.b.h. Many trees cut for skidways and decking grounds were defective or poorly formed.

It is evident that loss of advance reproduction, although of some importance, was not of serious consequence in this case, especially when one considers the numerous trees under 2 inches d.b.h. not included in this study but always present in the northern hardwood forest. With good supervision and care on the part of loggers, damage to young growth caused by partial cutting can be held to reasonable limits.

April 1945

Walter M. Zillgitt, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 235

Part-Time Woods Work of Northern Farmers Helpful in War Production

Operations in the old-growth hardwood forest on the Upper Peninsula Experimental Forest (Michigan) provide an object lesson of desirable integration of forests and farms in the northern Lake States. The management policy for this tract includes part-time employment for local farmers as one of its main objectives.

During 1944, 51 workers representing 43 forest families worked a total of 4,800 days on this forest, or 94 days per worker. They produced 573 M board feet of sawlogs and mine timbers, 2,544 cords of chemical wood, 528 cords of pulpwood, 227 cedar tie bolts, and 48 cords of cedar lagging, or the total equivalent of 2,140 M board feet. In terms of cash wages, they received $630 per worker, or $750 per family. Each thousand board feet of all products cut provided on the average 2-1/4 days' work for a forest resident, at about $6.70 per day in wages.

Although in normal years, proceeds from work on the forest might drop to $400 or $500 per family, this amount is a very significant item in the farm family income. Local residents also derived additional income from trucking and milling of the products. This example serves to illustrate the importance of woods employment in the economy of Michigan's Upper Peninsula.

The opportunity for the farmers to integrate their agricultural tasks with woods jobs is important not only because of the additional income they obtain, but also because the effectiveness of these workers in harvesting forest products for the war is greatly increased by the opportunity to live at home and work close by. Where it is necessary for them to find employment in logging camps at some distance from home, they are reluctant to "stick it out" and their total production is less.

April 1945

Walter M. Zillgitt, Silviculturist

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 236

Cross Tie Production in the Lake States

Over 4 million ties, equivalent to about 140 million board feet of lumber, were produced by the 700 tie mills operating in the Lake States in 1944. This equalled 11 percent of the total sawmill production of these states. Of these 4,120,000 ties, 46 percent were produced in Wisconsin, 32 percent were produced in Michigan, and 22 percent were produced in Minnesota.

Although the principal tie species in the Lake States was oak, maple, and birch, nearly 800,000 aspen, elm, ash, and miscellaneous hardwood ties were produced in 1944, together with 600,000 cedar, hemlock, and other softwood ties. However, the production of the less desirable species is expected to fall off, since most purchasers are now demanding a better tie than they accepted in 1944. Aspen, balm-of-Gilead, soft elm, black ash, etc. are acceptable in limited numbers, but only along with the better ties.

Lake States Tie Production, by Species, 1944.

Species	Minnesota	Wisconsin	Michigan	Region	Percent of total
		Number of ties			
Oak	121,000	1,052,000	82,000	1,255,000	30.5
Maple	51,000	362,000	482,000	895,000	21.7
Birch	107,000	97,000	360,000	564,000	13.7
Aspen 1/	269,000	56,000	105,000	430,000	10.4
Elm	28,000	121,000	31,000	180,000	4.4
Ash	58,000	60,000	14,000	132,000	3.2
Other 2/	5,000	14,000	32,000	51,000	1.2
Total hardwoods	639,000	1,762,000	1,106,000	3,507,000	85.1
Cedar	161,000	30,000	147,000	338,000	8.2
Hemlock	.....	76,000	68,000	144,000	3.5
Other 3/	100,000	10,000	21,000	131,000	3.2
Total softwoods	261,000	116,000	236,000	613,000	14.9
All species	900,000	1,878,000	1,342,000	4,120,000	100.0
Percent of 1943 production	96	115	116	111	

1/ Includes balm-of-Gilead. 2/ Beech, basswood, butternut, cherry, hickory, and walnut. 3/ Pine, tamarack, and spruce.

By grades, the ties produced in the Lake States in 1944 were 11 percent No. 5, 21 percent No. 4, 34 percent No. 3, 14 percent No. 2, 14 percent No. 1, and 6 percent serviceable rejects.

Although the 1944 cross tie production was 11 percent above that of 1943, it is anticipated by most dealers and producers - and confirmed by independent observation - that 1945 production will fall off considerably from that of 1944.

July 1945 Arthur G. Horn, Forest Economist

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 237

Mineral Soil is Favorable Seedbed For Spruce and Fir

That bare mineral soil is a much better seedbed than the original duff surface of the natural forest floor or duff shaded by a thin layer of logging slash is shown by an experiment with artificial seeding of white spruce, black spruce, and balsam fir under upland forest conditions in northeastern Minnesota. The following table shows the numbers of seedlings established per 100 seedsfive years after sowing:

Soil surface	Balsam fir	Black spruce	White spruce	All
		Clear cut area		
Mineral	25.8	29.5	26.8	27.4
Duff	2.5	0.2	0.2	1.0
Slash covered duff	1.5	0.2	0.5	0.7
		40-percent tree cover		
Mineral	37.2	18.0	42.5	32.6
Duff	1.2	0	0	.4
Slash covered duff	1.0	0	0	.3

Basis: 7,200 seeds equally distributed among species and plots.

In addition to the general and striking superiority of reproduction on mineral soil, some significant secondary reactions were observed. Among these are the greater success of balsam fir compared to the spruces on duff, and the relatively poor response of black spruce on mineral soil under tree cover.

It would appear that scarifying the soil with some kind of machine as a practical measure for encouraging regeneration of spruce and fir should be investigated. Disking has already proved a success with jack pine. Some changes in technique would have to be worked out because of the differences in seeding habits. Jack pine seed is dispersed from cones in the slash during the summer after logging. In contrast to this, balsam fir and white spruce seed are scattered during the autumn and winter after ripening while black spruce seed is disseminated slowly over a period of two or three years.

July 1945 Russell K. LeBarron, Silviculturist

Maintained by U. S. Department of Agriculture in cooperation with the University of Minnesota

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 238

Thinnings For Pulpwood Increase Timber Yield

The possibilities of increasing timber yield through frequent light thinnings are brought out in an experiment conducted on the Chippewa National Forest. In 1939 three one-acre plots in 30-year-old jack pine on good site having somewhat variable numbers of trees as a result of a preliminary non-commercial thinning 10 years previously were selected for study. In 1940 they were thinned by removing approximately four cords per acre of pulpwood. A fourth plot was unthinned. In 1944 an additional thinning removed about 4-1/2 cords from each plot, or a total of 8.6 to 9.1 cords per acre for the two treatments. The results of these light thinnings, which for the most part removed the weaker and less promising merchantable trees, are indicated below:

Plot treatment	Stand before thinning, 1939		Pulpwood1/ harvested 1940 and 1944	Stand after thinning, 1944		Periodic annual growth per acre 1939-1944
	Trees	Volume		Trees	Volume	
	No.	Cords	Cords	No.	Cords	Cords
Thinned 1940 and 1945	568	20.7	8.6	331	18.3	1.2
" " "	1104	21.8	8.7	637	20.7	1.5
" " "	1263	22.8	9.1	648	19.2	1.1
Unthinned	1472	26.0	....	814	27.1	.2

1/ Standard cords to a 3" top i.b.

The thinned plots grew at the rate of 1.1 to 1.5 cords per acre per year, which is considered excellent for jack pine whereas the net annual increment on the check plot was only .2 cord. The difference is largely explained by the natural mortality. The thinned plots lost from .3 to .6 cord during the 5-year period, but this material was salvaged. The unthinned plot lost 5.7 cords in trees that died. The utilization of weak trees before they die or immediately afterwards while still sound is a very important advantage derived from the thinning. Such utilization practice greatly increases yields over a rotation.

F. H. Eyre, Silviculturist
Paul J. Zehngraff, Silviculturist

July 1945

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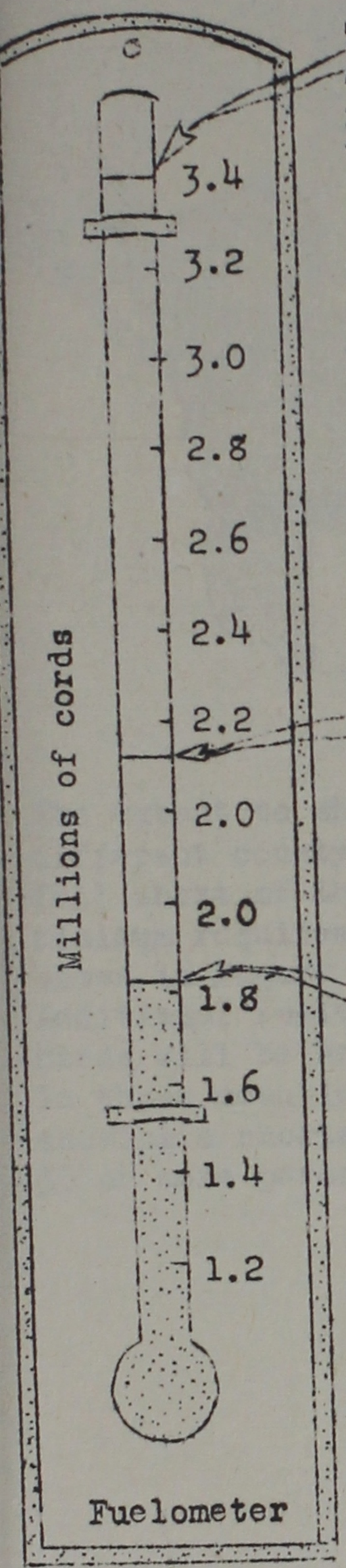
TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 239

Fuelwood Production Lags in Wisconsin



The supply of fuelwood in Wisconsin, unless greatly augmented during the next six months, will be inadequate to fill the gap reported in coal and oil supplies, according to a survey made by the Lake States Forest Experiment Station. Only through a substantial increase in cordwood production and through salvage of sawmill slabs, edgings, sawdust, etc., will sufficient fuels be available to meet requirements.

NORMAL PREWAR PRODUCTION in Wisconsin was about 3,400,000 cords.

MINIMUM NEEDS for 1945 are 2,138,000 cords, and even greater production would be desirable to offset the expected decline in coal supplies.

1945 PRODUCTION will be about 1,812,000 cords, or 3 percent less than the 1,869,000 cords produced in 1944.

Forest cordwood, which comes primarily from cuttings in standing timber, from land clearing operations, and from salvage in logging operations makes up about 82 percent of the total volume of fuelwood used. Edgings slabs, old boards, and the like comprise about 17 percent and sawdust about 1 percent.

The principal factors responsible for current inadequate fuelwood production are labor shortage, lack of sufficient trucks and labor saving equipment, and lack of full understanding of the potential shortage of other fuels.

The best source of additional fuelwood is believed to be salvage of dead and defective trees on public forests, farmwoods, and vacant lots, and the salvage of waste material around farms and cities.

Stimulation of fuelwood production through organization of wood cutting bees, cooperative purchase of stumpage and rental of equipment will help forestall a great deal of inconvenience and discomfort during the coming winter.

July 1945

William A. Kluender, Forest Economist

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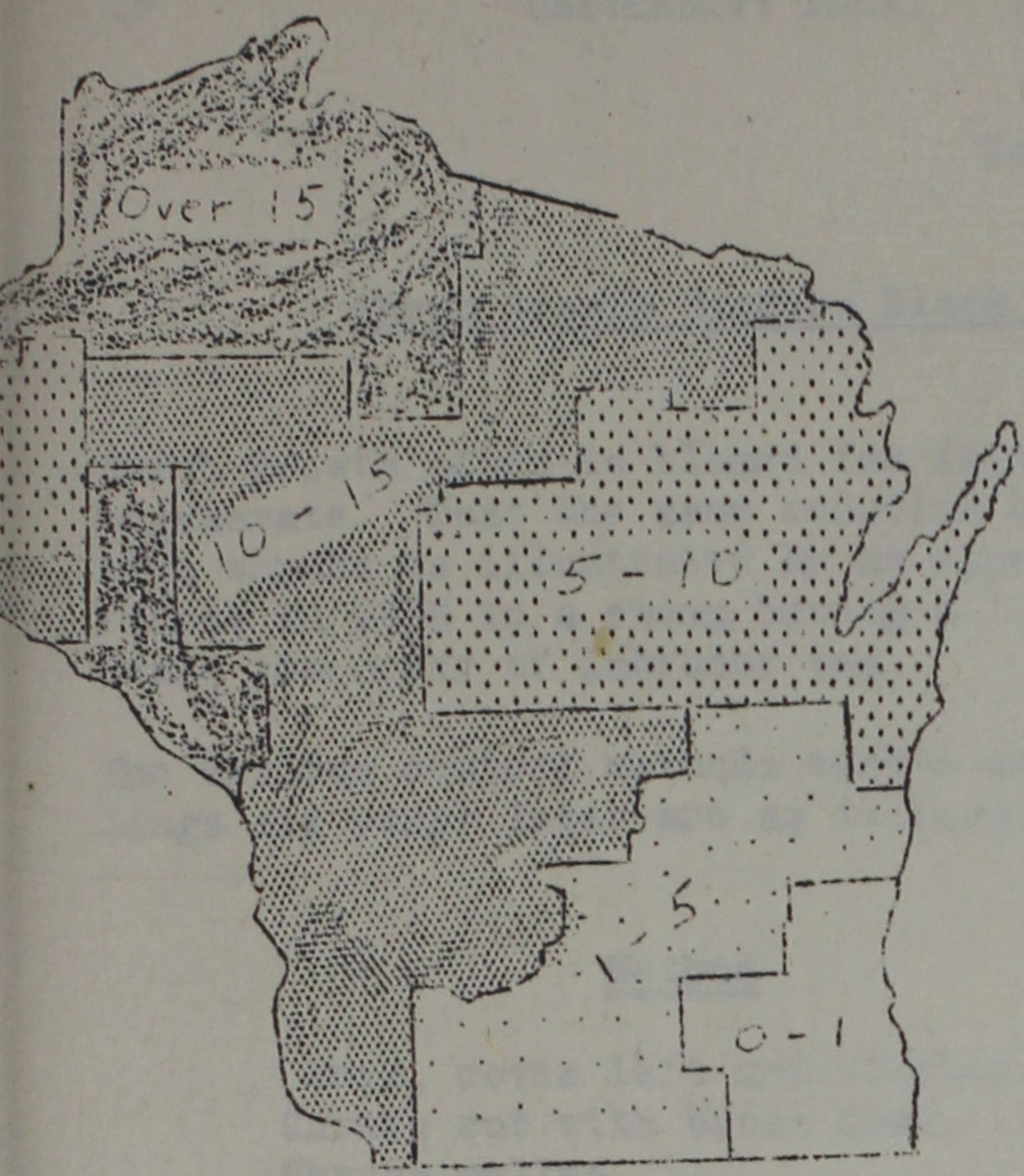
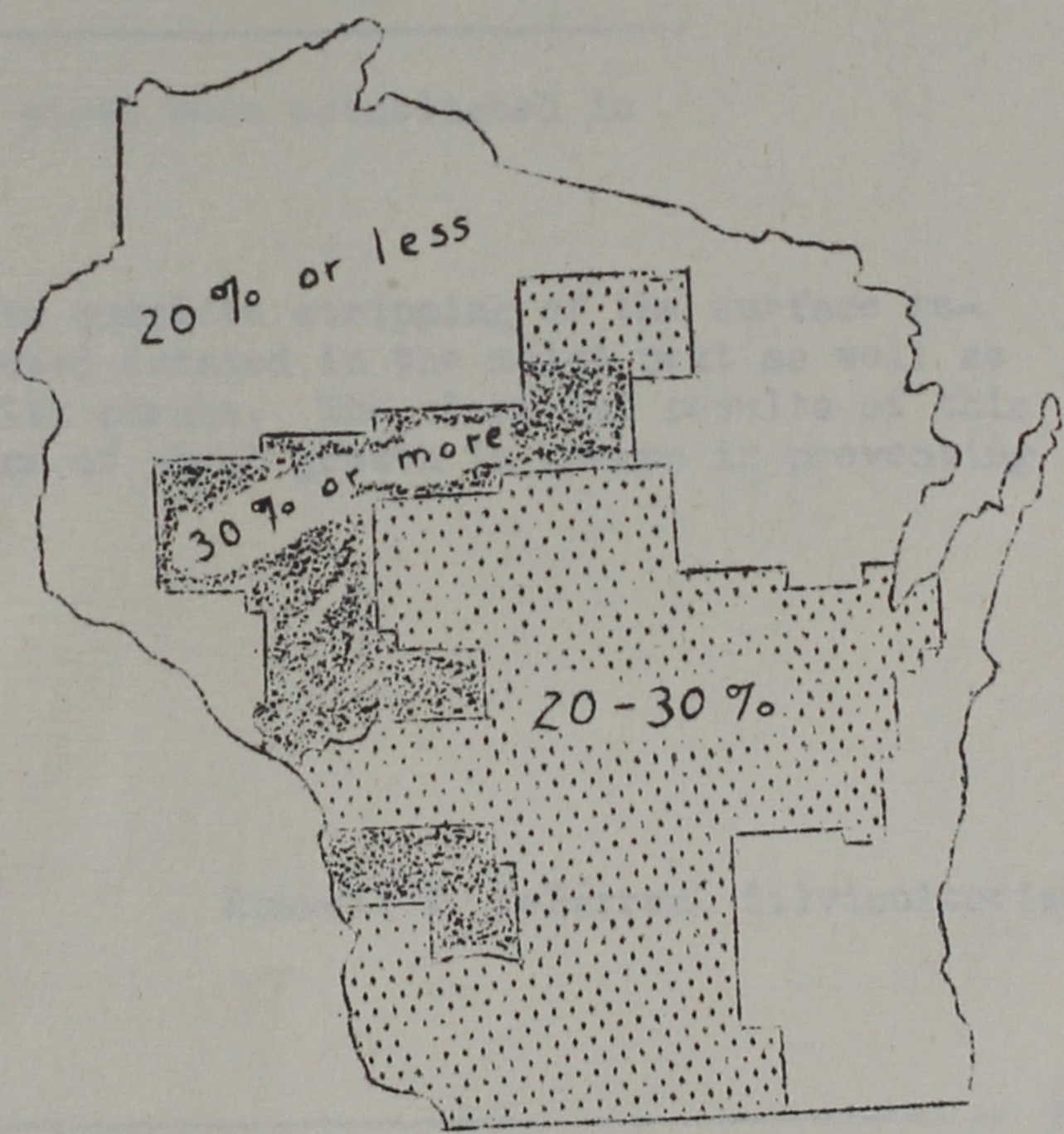
Figure 1.--Estimated number of cords of cordwood produced per farm annually.



Heaviest fuelwood production in Wisconsin is in the northwestern part of the state where upwards of 15 cords are produced on the average farm. A belt of moderately heavy production, 10 to 15 cords per farm, extends up the western side of the state to the northeastern forested counties. The lightest production is in the southeast corner where very little timber acreage is to be found. These differences are shown in Figure 1.

Figure 2.--Estimated fuelwood shortage for 1945 by areas in percent.

The extent to which the different county groups fall short of their minimum requirements is shown in Figure 2. Additional fuelwood needs will be heaviest in those counties showing a shortage of 30 or more percent.



TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 240

Shrub Growth Hinders Black Spruce Reproduction in Swamps

Shrub growth often is blamed for failure of various upland tree species to regenerate. That the same reaction may be expected in swamps overgrown with shrubs is illustrated by an experiment begun on the Superior National Forest in 1938 in a swamp having a light overstory of black spruce and a dense low cover of Labrador tea.

The various control methods tested and the stocking of black spruce seedlings six years later are as follows:

Method	Seedlings per acre 1/
Check, cover left undisturbed.....	0
Shrubs cut with brush hook.....	544
Shrubs pulled.....	3,049
Shrubs, litter, and mosses stripped off with hoe.....	8,385

Basis: 16 plots each 10 x 10 ft. in size.

1/ Trees present when the plots were established in 1938 are not included.

The exceptionally good response to complete stripping of the surface reflects in part the favorable seedbed created in the moist peat as well as the elimination of competition with shrubs. The clear cut results of this experiment indicate the importance of shrub growth in swamps in preventing restocking with spruce.

July 1945

Russell K. LeBarron, Silviculturist

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 241

A Composite Cordwood Volume Table for Pulpwood Species in the Lake States

Because there is very little difference in the stacked unpeeled volumes of most native trees cut for pulpwood in the Lake States, a generalized cordwood table can be used. Technical Note 202 (August 1943) presented a table for trees from 6 to 14 inches d.b.h. and 1 to 7 bolts in useable height. Because of the demand for similar information for both smaller and larger trees, a new table of greater range has been prepared.

D.B.H.	Useable height in number of 8-foot bolts							
	1	2	3	4	5	6	7	8
Inches	Volume in cords*							
4	.004	.008						
5	.010	.018	.027					
6	.018	.030	.043	.058				
7	.025	.039	.056	.074	.093			
8	.032	.050	.070	.092	.116	.138		
9	.040	.061	.085	.112	.140	.168		
10	.049	.074	.101	.132	.167	.200	.239	.270
11	.059	.087	.119	.155	.195	.233	.280	.320
12	.070	.100	.138	.180	.225	.271	.324	.365
13	.082	.116	.158	.206	.257	.310	.370	.417
14	.095	.134	.179	.233	.291	.351	.419	.472
15			.200	.260	.325	.393	.469	.528
16			.222	.290	.361	.437	.521	.587
17			.245	.320	.399	.483	.577	.650
18			.270	.350	.439	.531	.634	.715
19			.295	.382	.480	.581	.693	.781
20			.321	.416	.522	.632	.755	.851
21				.452	.566	.685	.818	.922
22				.490	.612	.739	.883	.995
23					.659	.796	.950	1.07
24						.855	1.02	1.15
25						.914	1.09	1.23

* Volume in stem above one-foot stump in standard unpeeled cords. Height is number of useable 8-foot bolts to a variable top diameter not less than 4 inches inside bark.

October 1945

S. R. GEVORKIANTZ, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 242

Forest Fire Control Pays

Remarkable progress has been made in state forest fire control in the Lake States during the last 15 years. This is borne out by the reduction in number of fires, area burned, size of average fire, and the annual fire loss for each succeeding 5-year period. Although the good record for the most recent period (1940-44) has been in part a result of favorable weather conditions, most of the improvement can be ascribed to better financed and better organized state fire control. Reductions of 67 percent in the number of fires occurring annually, 92 percent in the area burned, 77 percent in the size of the average fire, and 90 percent in the average annual loss have occurred since 1930 on state-protected lands in the Lake States.

Although some 2,800 fires still burn about 65,000 acres annually, the risk of burning has been reduced over 13 times, or from 1.74 to 0.13 percent of the area protected. This improvement in protection has made timber growing more feasible and forest property an insurable risk. Presuppression expenditures have gone up 63 percent since 1930, but suppression costs have been reduced 80 percent. As a result, the net over-all cost of fire control has increased less than 14 percent while the over-all Cost-plus-Loss has been cut 40 percent.

The record for 5-year periods, by States, and the percent change between the first and last period are as follows:

October 1945 J. A. Mitchell, Silviculturist

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Period	Fires per 100,000 acres	Size of average fire	Protected area burned	Ave. loss per acre protected	Fires over 10 acres	Presuppression expenditures per acre protected	Suppression expenditures per acre protected	Cost plus-Loss per acre protected
	No.	Acres	%	$	%	$	$	$
LAKE STATES: Combined data for state-protected land								
1930-34	17.8	97.4	1.74	0.030	36.4	0.019	0.010	0.059
1935-39	8.8	36.2	0.36	0.009	23.0	0.023	0.005	0.037
1940-44	5.9	22.5	0.13	0.003	19.2	0.031	0.002	0.035
% Change	-66.9	-76.9	-92.5	-90.0	-47.3	+63.2	-80.0	-40.7
MICHIGAN: State-protected land								
1930-34	20.0	41.5	0.91	0.007	27.0	0.022	0.010	0.039
1935-39	10.0	20.3	0.20	0.005	14.3	0.031	0.003	0.038
1940-44	7.0	16.7	0.10	0.003	15.7	0.042	0.002	0.047
%Change	-45.0	-59.8	-89.0	-57.1	-41.9	+90.9	-80.0	+20.5
MINNESOTA: State-protected land								
1930-34	13.0	149.7	2.01	0.053	44.0	0.015	0.009	0.077
1935-39	6.6	76.8	0.60	0.017	33.0	0.016	0.007	0.040
1940-44	3.4	56.7	0.22	0.004	41.6	0.019	0.001	0.024
% Change	-73.9	-62.1	-89.1	-92.5	-5.4	+26.7	-88.9	-68.8
WISCONSIN: State-protected land								
1930-34	22.2	130.4	2.54	0.026	43.0	0.020	0.013	0.054
1935-39	10.6	13.0	0.18	0.003	7.4	0.026	0.004	0.032
1940-44	8.2	6.8	0.06	0.001	8.7	0.034	0.002	0.037
% Change	-63.1	-94.8	-97.6	-96.2	-79.8	+70.0	-84.6	-31.5

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERISTY FARM, ST. PAUL 8, MINNESOTA

No. 243

Minnesota Pole Requirements Heavy

Large numbers of telephone, telegraph and power poles will be required in Minnesota during the first postwar years to extend lines to additional rural homes and to renovate systems which have had but a minimum of maintenance for several years. Annual need for upwards of 200,000 poles seems certain.

Before the war, it was estimated that 3.8 million poles were in use in Minnesota and 213,000 replacements or new installations were needed annually. Deferred maintenance and proposed new construction will tend to raise this number during the next few years. However, poles now being set are mostly treated and should outlast the poles already in service. Annual renewals therefore should decline after the first few years.

Number poles used annually in Minnesota, 1936 and 1937

Purpose	Total	Local				Imported	
		White cedar	Oak	Tamarack	Pine	Western cedar	Southern pine
	Thousand pieces						
Telephone	115	92	5	10	1	5	2
Telegraph	20	6	0	0	0	14	0
Power	78	7	0	0	0	46	25
	213	105	5	10	1	65	27

Local poles made up 57 percent of the annual consumption in 1936 and 1937, the largest proportion being white cedar. More local poles were used for telephone lines than for telegraph and power.

During the war, because of the growing shortage of cedar pole timber in the Lake States and the difficulty in maintaining full crews in the woods, telephone and power companies have had to depend to an even greater extent upon imported timbers. In addition to western cedar and southern pine, lodgepole, treated full length, has become a significant item in the Minnesota pole market. Experiments are now under way to determine the suitability of full length treated jack and red pine poles for standard line construction. Greater dependence may have to be placed on these and other species to fill the expected high demand.

October 1945

R.N.Cunningham, Forest Economist

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 244

Reforestation Retarded by War

Forest planting activity was an important if little recognized war casualty in the Lake States, according to statistics compiled at the Lake States Forest Experiment Station. During the prewar days when abundant Civilian Conservation Corps and W.P.A. labor were available, as much as 148,000 acres were planted to trees in one year in the three Lake States. During 1944 the corresponding figure was only 8,000 acres. While the war was on and labor was critically short, it was logical to concentrate efforts on wood production. Now that peace has been restored, attention should again be directed to rebuilding our depleted forest resource.

The table below shows the total area planted by all agencies in the Lake States at the close of 1932 (before emergency labor became available), from 1933 to the close of 1941 (our entry into the war), from 1942 to the close of 1944, and the cumulative total at the close of 1944 (the latest statistics available).

Total net area planted by all agencies in the Lake States 1/

State	Thru 1932	1933-1941	1942-1944	Thru 1944
	M acres	M acres	M acres	M acres
Minnesota	100	120	10	230
Wisconsin	35	325	40	400
Michigan	230	490	45	765
Lake States	365	935	95	1,395

1/ Figures given in round numbers.

October 1945

Paul O. Rudolf, Silviculturist

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 245

Wind Movement in the Plains

Because winds contribute to soil losses and crop damage in the Plains, and because Weather Bureau wind records are not applicable to open fields, records obtained in 1936 by the Lake States Forest Experiment Station at 5 latitudes are of interest to conservation agencies. Wind velocities were recorded at heights of 16 inches and 16 feet in fields which were as "flat" as possible, covered with grass which was mowed regularly, and free from impediments for considerable distances (except at Holdrege, where south winds were somewhat reduced). In 1936 there was generally less wind than normal in the early, very cold months and more than normal in the subsequent very hot period.

In the table below, for each station three wind velocities are given: (a) at the 16-inch level, (b) at the 16-foot level, and (c) "normalized" for open-field conditions at the 16-foot level. (This is the ratio to current velocities of nearest Weather Bureau stations, computed by 3-month periods, thus avoiding the extremes of single months. Long-term averages for each month of a season, for same stations, have then been multiplied by this ratio.)

Station		Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Year
		Average wind velocities in m.p.h. (with instrument corrections)												
Towner, N.D.	(a)	7.9	7.0	8.0	9.3	7.1	7.4	6.8	7.0	5.9	7.6	7.6	7.4	7.4
	(b)	11.0	8.6	9.8	12.4	10.7	11.5	10.6	10.4	8.9	10.9	10.8	10.4	10.5
	(c)	10.5	10.7	11.1	11.1	11.5	11.2	10.4	9.2	9.4	10.0	10.2	10.5	10.5
Huron, S.D.	(a)	7.4	6.7	8.5	8.1	8.3	8.1	8.2	8.3	7.6	7.6	7.9	8.5	7.9
	(b)	10.3	9.2	11.0	11.8	11.7	12.2	12.6	12.1	11.2	11.3	11.5	12.1	11.4
	(c)	11.4	11.5	11.9	12.4	12.7	12.3	11.2	10.4	10.5	11.0	11.4	11.5	11.5
Holdrege, Nebr.	(a)	7.1	7.7	8.4	9.8	9.4	8.2	7.5	7.6	6.8	8.2	7.7	8.5	8.1
	(b)	9.8	10.2	11.0	13.2	12.7	11.8	11.1	11.3	10.1	11.9	10.8	11.9	11.3
	(c)	11.1	11.4	12.1	12.5	12.8	11.6	10.8	9.9	9.7	10.4	11.0	11.6	11.2
Dodge City, Kans.	(a)	8.4	8.6	9.3	11.0	10.9	9.6	7.7	8.1	7.6	9.2	8.2	8.1	8.9
	(b)	12.0	11.5	12.3	14.7	14.3	13.7	12.2	12.2	11.1	13.5	12.1	12.1	12.6
	(c)	11.5	11.8	12.5	13.9	14.9	13.4	12.8	11.9	11.7	12.8	12.5	11.9	12.6
Childress, Tex.	(a)	....	6.9	7.3	8.3	8.6	8.3	6.9	....	....	....	....	....	....
	(b)	....	9.6	9.6	10.9	11.5	10.9	9.3	....	....	....	....	....	....
	(c)	9.8	9.6	10.5	10.8	11.7	10.7	9.8	9.4	9.0	9.9	9.7	9.6	10.0

Computations for the above table brought out the fact that open-field velocities are especially high in winter as compared to velocities at Weather Bureau stations in town. This is even more true at 16 inches than at 16 feet, as the "friction" effect of snow-covered fields is low.

October 1945 C. G. Bates, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 246

Treated Paper Birch and Aspen Posts Give Good Service

Since 1938 the Lake States Forest Experiment Station has carried on a durability test of treated and untreated fence posts at the Upper Mississippi Valley Soil Conservation Experiment Station 1/ near La Crosse, Wisconsin. The durability of aspen and paper birch posts and some other species treated with about one pound of zinc chloride each 2/ was compared with untreated red and white oak. Results based on an examination of some 180 posts in 1945 were as follows:

1. All unseasoned aspen posts treated in 1938 and 1939 were serviceable in 1945 whereas untreated ones failed from rot at the ground line within 2 years. Peeling did not increase durability in either case.

2. During the same period green paper birch posts similarly treated likewise resisted all decay at the ground line, but 1/5 of them showed various degrees of rot in the top -- although not to the extent necessitating replacement. Top rot was slightly less common in peeled posts. End dipping of tops in hot asphalt to provide protective "caps" increased decay. Apparently this practice prevented unseasoned wood from drying out.

3. Top-rotted posts generally had spotty distribution of zinc chloride. If the tops of freshly treated posts were checked with a chemical indicator or if some preservative salt, such as chromated zinc chloride, which imparts a color were used, the inadequacy of treatment could be detected immediately and remedied before posts are placed in service.

4. Forty percent of the red oak posts and 27 percent of the white oak rotted off at the ground line within 7 years. Seasoning did not increase durability.

5. None of the treated shag-bark hickory has failed. However, the sapwood of hickory is very difficult to impregnate and this species is not recommended.

These results show that farmers in southwestern Wisconsin will do well to utilize small birch and aspen for fence posts after first treating them with zinc chloride or chromated zinc chloride. Such posts will outlast untreated red oak and possibly white oak. Treatment costs no more than the cash outlay for seasoned white oak posts and is substantially less than for commercial cedar or steel posts. The early removal and use of birch and aspen is also good forest management because it provides more growing space for such high-grade lumber species as oak, sugar maple, basswood, and ash.

1/ Ed Lemke of the Soil Conservation Service rendered valuable help.
2/ Wirka, R. M. Tire Tube Method of Fence Post Treatment (Revised Feb. 1945). Mimeo. No. R1158, Forest Products Laboratory, Madison, Wisconsin

January 1946 — Harold F. Scholz, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 247

Stand Changes Following Light Selection Cutting

That stand composition can be maintained by proper cutting practice is shown by a mature northern hardwood stand on the Upper Peninsula Experimental Forest, Dukes, Michigan. This stand was given a light selection cut in 1926 and again in 1943. Stand tables were prepared at the time of each cutting.

Analysis of the data showed that the general pattern of the stand had not been affected to any great extent by the two cuttings. The chief changes were an increase in number of small trees which came in following the 1926 cutting and a decrease in large trees 25 inches d.b.h. and over.

As shown by the following tabulation, the total number of stems was greater before cutting in 1943 than before cutting in 1926, and greater after cutting in 1943 than after cutting in 1926. In these particular cuttings the species ratios remained about constant.

Total Number of Trees 5" D.B.H. and Over on 19.25 Acres

Major species group	Before cutting				After cutting			
	1926		1943		1926		1943	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Sugar maple	1839	80	2015	78	1655	80	1689	79
Yellow birch	222	10	241	9	196	9	163	8
Other hardwoods	197	9	294	11	196	9	251	12
Softwoods	33	1	45	2	31	2	30	1
Total	2291	100	2685	100	2078	100	2133	100

In the 17 years following the first cutting the stand more than regained its initial stocking in basal area as well as in total number of trees.

January 1946

W. M. Zillgitt, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 248

Minnesota Woodlot Yields Valuable Crop

River bottomland subject to seasonal flooding may be a profitable part of the farm if maintained as a woodlot. This is illustrated by an 8.8 acre timber tract on the Theodore A. Larson farm south of St. Peter, Minnesota. This woodlot has yielded 14,000 board feet or 323 cords of wood in the last 35 years, or at the rate of more than one cord per acre per year. A logging job during the winter of 1944-45 removed about 52 percent of the total volume and yielded $967 for stumpage and $700 for labor and equipment hire. The stumpage return was equivalent to $3.14 per acre per year over the 35-year period. An approximately equal quantity of timber will be harvested from mature trees during the coming winter. In addition, a considerable quantity of logs and fuel has been removed from the tract for home consumption.

The cottonwood bolts taken in the last cutting (some up to 30 inches in diameter) were shipped to Cloquet to the match factory. About 1,500 board feet of sawlogs were cut for use on the farm. Tops and unmerchantable small trees were made into firewood.

The Larson woodlot consists mostly of cottonwood, elm, ash, oak, soft maple and willow. To make the tract fully productive the owner planted the openings with cottonwood cuttings. For 25 years the tract was unpastured, but it has been grazed very lightly during the past 10 years. It is of little value for farming because of annual flooding, but is ideal for timber production.

Wartime prices may have brought a somewhat higher cash return for stumpage and labor than can be expected under normal conditions. However, an annual growth of one cord or about 400 board feet per acre per year guarantees a very favorable return for this non-agricultural land.

January 1946

J. R. Neetzel, Forester

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 249

Slash Removal an Important Factor in Restocking Cut-Over Spruce Swamps

What is the influence of slash on the regeneration of cut over black spruce swamps?

To throw light on this question a study of various methods of slash disposal in a partially-cut black spruce stand was begun in 1938 in cooperation with the Superior National Forest. These methods were (1) lop and scatter, (2) pile and burn, (3) pile, (4) no disposal.

An examination made in August 1945 shows quite conclusively that slash plays an important part in the establishment of reproduction on such areas.

Slash treatment	Seedlings per acre					
	Black spruce	Balsam fir	Total pulpwood	White cedar	Paper birch	Total all
	Number	Number	Number	Number	Number	Number
Piled	3,184	2,333	5,517	2,750	2,916	11,183
Piled and burned	2,533	2,416	4,949	2,068	2,033	9,050
Lopped and scattered	1,500	1,700	3,200	2,915	1,317	7,432
None	1,860	2,060	3,920	1,400	1,380	6,700

The advantage gained by actual removal of the slash -- piling and piling and burning -- over lopping and no disposal is considerable. Seedlings of black spruce and balsam fir, the pulpwood species, are not only much more numerous but the distribution of the spruce is much better where the slash was removed. Birch seedlings also show this relationship but to a lesser degree. Cedar, however, does not, due to the fact that most of its reproduction is of layer origin and was present before logging.

The superiority of reproduction where the slash was removed is believed due to the larger area of favorable seedbed surface. This is also the probable explanation for rhe greater amount of reproduction and its better stocking on the areas where the slash was allowed to lay as it fell compared to those where it was lopped and scattered, thus covering up more of the seedbed. The latter method is thus worse than no disposal at all. On clear-cut areas where the seed supply is not continuing, the differences in favor of slash removal might be even more striking.

January 1946

E. I. Roe, Silviculturist

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 250

Season of Cutting Affects Aspen Sprouting

The prolific reproduction from root sprouts or suckers commonly occurring in aspen stands clear cut during the fall and winter does not take place when logging is done at other seasons, according to studies made by the Lake States Forest Experiment Station in northern Minnesota.

With the increased demand for peeled pulpwood during the war, it became necessary to log during the spring and early summer as well as in the fall and winter so as to take full advantage of the bark peeling season. When it was observed that many clear cut aspen areas failed to reproduce well, several of these cut during the past few years were examined in the fall of 1944. As shown below, sprouting following summer logging was much less than that resulting from winter logging.

Season of logging		Aspen clumps per acre	Aspen stems per acre	Height of aspen sprouts	Brush stems per acre	Brush height
		Number	Number	Feet	Number	Feet
Area 1						
Summer	1941	750	1,250	6.4	30,800	6.0
Fall - winter	1941	3,400	6,100	6.9	23,300	5.0
Fall - winter	1942	5,850	11,850	6.6	12,850	3.5
Area 2						
Spring	1943	4,100	8,550	6.4	10,750	3.1
Summer	1943	2,750	4,700	3.2	8,400	2.7
Fall - winter	1943	7,100	22,850	4.4	9,500	3.0

On areas logged during the spring, suckers are not produced until midsummer. These are not thoroughly hardened-off by fall, consequently some of them are winter killed. In the case of summer logging, suckers may not be produced until midsummer of the following year. The hazel and other brush, which in the meantime has had one summer to recuperate from logging damage, then provides severe competition for newly established aspen suckers. In contrast, suckers arising from winter logging are established the following summer. They get an even start with the brush, and because of their rapid growth, can keep ahead of the competing vegetation.

January 1946 P. J. Zehngraff, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 251

How to Improve Aspen Stocking Following Summer Logging

Although summer logging results in less satisfactory regeneration of aspen than fall or winter logging (see Technical Note No. 250), the increasing demand for peeled aspen pulpwood makes it desirable to cut during spring and summer when the bark can be easily stripped.

In trying to stimulate sprouting of aspen following summer logging, an area of 10 acres in the Pike Bay Experimental Forest was disked with an Athens type disk plow in the spring of 1945. The area chosen had been clear cut in the summer of 1942. It had become extremely brushy and had failed to reproduce satisfactorily.

A reproduction count made in late August 1945 gave the following results:

Treatment	Stocking	Clumps per acre	Stems per acre
	Percent	Number	Number
No disking.....	60	750	1,250
Disked 50 ft. or more from standing cull trees.....	91	2,400	5,300
Disked 50 ft. or less from standing cull trees.....	100	5,300	14,630

This preliminary test gives very promising results. It seems that a large number of living aspen roots remain in the ground for at least three years following logging. Disking, by eliminating the brush competition and probably by stimulating aspen suckering, brought about satisfactory aspen regeneration on this summer-logged area.

April 1946

Paul J. Zehngraff, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST PAUL 8, MINNESOTA

No. 252

Most Lake States Lumber Now Produced by Smaller Sawmills

Not over a decade ago some 40 large[1/] mills sawed over 70 percent of all the lumber produced in the Lake States. Since then the production of the smaller mills has increased, especially during the war, so that now it far exceeds that of the large mills. The tabulation below shows that medium and small mill lumber production in 1945 accounted for more than 70 percent of the total. This complete reversal in the past 10 years has been caused principally by a gradual reduction of old growth timber which has forced many large sawmills to close. More large mills will undoubtedly shut down operations when their old growth is gone.

Lumber production according to size of mill
(1941-1945)

Year	Minnesota		Wisconsin		Michigan		Lake States Region	
	Large mills	Medium and small mills	Large mills	Medium and small mills	Large Mills	Medium and small mills	Large mills	Medium and small mills
	Million bd.ft.		Million bd.ft.		Million bd.ft.		Million bd.ft.	
1941	29.8	168.4	278.6	195.1	368.2	185.7	676.6	549.2
1942	19.2	212.6	267.6	216.2	318.7	212.4	605.5	641.2
1943	11.5	184.2	169.0	222.5	203.6	203.3	384.1	610.0
1944	6.7	240.2	163.8	269.4	205.5	347.3	376.0	856.9
1945	5.6	228.1	120.6	202.9	164.6	303.1	290.8	734.1

Note: (1941-1943 inclusive - Bureau Census figures.
(1944-1945 - U.S.F.S. & N.H.H.A. figures prepared in cooperation with C.P.A.)

Although the smaller mills show a substantial increase in production during recent years, a part of this resulted from more complete coverage by the census takers. A fairly large percentage of the output of these small mills never reaches commercial markets, so even now large mills produce more lumber for commercial markets than do the smaller mills. On the other hand, practically all the custom-sawed lumber and most of the railroad cross-ties are manufactured by the smaller mills.

1/ Large mills - those producing 5 million board feet or more per year.

April 1946

Arthur G. Horn, Forest Economist

Maintained by the U. S. Department of Agriculture, Forest Service,
in cooperation with the University of Minnesota

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 253

Cutting Immature Oak Timber Sacrifices Quality Increment

For quality increment hold timber until mature; that is the main finding of an analysis of 150 red oak trees in two fully stocked stands in La Crosse and Sauk Counties, Wisconsin. In the 80-year-old La Crosse County stand on very good site, the volume of No. 1 logs during the last 30 years increased from 18 to 53 percent of the total for all grades. The increase for the 100-year-old Sauk County stand on good site was from 9 to 44 percent. As graded logs f.o.b. mill at recent ceiling prices, i.e., $60.00 per M bd.ft. Scrib. Dec. C, for No. 1 logs, $29.00 for No. 2 logs, and $21.00 for the No. 3 grade, the corresponding 30-year increase in average gross value per M bd.ft. was from $29.48 to $42.61 for the 80-year-old stand and from $25.63 to $39.76 for the 100-year-old tract. Although log prices will vary, No. 1 logs, produced in abundance only in mature stands, will doubtless retain a relatively high value. The 80-year-old woodlot was logged to a minimum diameter of 13.5 inches d.b.h. and the 100-year-old stand to about 11 inches d.b.h. in 1944 for tie bolts and lumber. Volume figures below exclude sections less than 8 ft. in length and under 7 inches in diameter.

D.B.H. when cut	Volume cut at 80 years: Distribution by log grades			Volume cut at 100 years 1/: Distribution by log grades		
	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3
Inches	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.
11-13	...	...	...	0	270	770
14	198	330	572	157	261	452
15	735	267	668	650	91	559
16-27	11,220	2,005	6,825	5,080	1,890	2,990
Total	12,153	2,602	8,065	5,887	2,512	4,771
2/Val.	$42.61; Vol. 22,820 bd.ft.			Val. $39.76; Vol. 13,170 bd.ft.		
	3/ Volume at age 70			3/ Volume at age 90		
11-13	...	...	...	0	205	615
14	0	239	681	0	243	487
15	0	300	900	0	328	582
16-27	7,900	1,970	5,310	2,780	2,030	2,700
Total	7,900	2,509	6,891	2,780	2,806	4,384
2/Val.	$39.75; Vol. 17,300 bd.ft.			Val. $33.95; Vol. 9,970 bd.ft.		
	3/ Volume at age 50			3/ Volume at age 70		
11-13	...	...	...	0	0	0
14	0	0	270	0	0	150
15	0	0	300	0	0	190
16-27	1,360	1,290	4,150	329	526	2,435
Total	1,360	1,290	4,720	329	526	2,775
2/Val.	$29.48; Vol. 7,370 bd.ft.			Val. $25.63; Vol. 3,630 bd.ft.		

1/ Total volume at actual harvest. 2/ Average value of logs per M bd.ft. f.o.b. mill. 3/ Total volume which could have been cut from stand at this age.

April 1946

Harold F. Scholz, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 8, MINNESOTA

No. 254

Successful Jack Pine Regeneration in Lower Michigan

Although jack pine regeneration has been successfully obtained on some 2,000 acres in northern Minnesota through a combination of disking of the soil and uniform scattering of cone-bearing slash, a few early trials in Lower Michigan were unsuccessful. However, a test started about 10 years ago by the Lake States Forest Experiment Station on the Huron National Forest has given reasonably good regeneration of jack pine using these methods.

An open, 60-year-old stand of jack pine was cut in August 1936 removing 3-1/3 cords per acre out of a total of 10 cords. After cutting the area was broadcast burned. At the end of 1939 there were no jack pine seedlings present, although 223,000 sound jack pine seed per acre had been released from slash and standing trees since cutting. Accordingly a second cut, removing an additional 3-1/3 cords, was made in March 1940. This time the soil was disked thoroughly prior to cutting. As before, the slash was scattered uniformly over the area. The resulting jack pine regeneration as shown below is considered reasonably satisfactory.

Jack pine reproduction*	May 1940	October 1940	October 1945
Seedlings per acre	1,630	3,330	1,800
Stocked mil-acre quadrats per acre	770	800	667

*In 1945 there were an additional 400 seedlings per acre of oak and red maple, which stocked 100 mil-acres per acre not already occupied by jack pine.

About 5 percent of the pine seedlings are infested by gall rust and will probably succumb. Also most seedlings have had their growth retarded by deer browsing. However, barring some catastrophe, these should grow into a moderately stocked jack pine stand.

April 1946 Paul O. Rudolf, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM No. 25 ST. PAUL 1, MINNESOTA

A Quick Method of Estimating Cull in Northern Hardwood Stands[1]

In estimating merchantable timber volumes cruisers need a systematic method of determining cull. For northern hardwood saw timber, a fair approximation of cull percent can be obtained quickly by the following method:

1. For each 20- to 40-acre tract, examine a minimum of 40 or 50 trees as they come in the stand. Record the cull class for each tree on the basis of visible defects.
   Class 1 - Trees with no major visible defect;[2] minor defect[3] permitted.
   Class 2 - Trees with one major visible defect.
   Class 3 - Trees with two major visible defects.
   Class 4 - Trees with three or more major visible defects.
   [2] Major Visible Defects: Butt rot, conk, canker, large or spiral seam, large crack, large scar, large hole, large rotten burl, large broken or dead limb or fork, broken or dead top, serious crook or sweep, abnormally short merchantable length.
   [3] Minor Defects: Ingrown bark, sterile conk, small seam, small crack, small scar, small hole, small rotten burl, small broken or dead limb, slight crook or sweep.
2. Determine gross volume of each sample tree. Use board foot volume table No. 1 in Technical Note No. 203 for Lake States conditions.
3. Compute the cull volume of each tree by applying the following percentage deductions to gross volumes.
   Class 1, 5; class 2, 15; class 3, 35; class 4, 60; (if 100 percent cull trees excluded from sample) or 70 (if 100 percent cull trees included in sample).
4. Determine gross volume and cull volume for the entire sample.
5. Divide the cull volume by the gross volume to determine the cull percent applicable to the stand.

To increase the accuracy of the cull cruise do these things:

a. Consider a single defect culling the first 16-foot log as two defects.
b. Consider a single defect extending into two 16-foot logs as two defects; if into three logs, count as three defects.
c. Any defect in the top log should be considered minor for trees 15 inches, d.b.h. and larger, unless it completely culls the section.
d. Where two or more defects will cut out together, consider as one defect.
e. Minor defects so numerous or extensive as to equal a major defect in loss of scale should be considered as one major defect.
f. Always throw borderline cases into the higher class to compensate for hidden defect.

The cull percent obtained by this method is most accurate for stands averaging 2½ logs. Increase the percentage by one-third for 1-log stands, by 10 percent for 2-log stands; decrease it by 10 percent for 3-log stands, and by one-fourth for 4-log stands.

1/ S. R. Gevorkiantz and W. A. Salminen assisted in the development of this method.

April 1946 W. M. ZILLGITT, Silviculturist

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 256

Restocking Black Spruce Swamps by Planting

That cut over black spruce swamps can be successfully restocked by planting is indicated by a test made on the Superior National Forest, Minnesota, in the spring of 1938. 2-1 black spruce trees were bar-planted at a spacing of 4 by 4 feet directly in a heavy growth of live sphagnum moss overlying peat. The moss was so wet that regular slits could not be made, so much of the shaping of the hole and subsequent firming of the moss around the roots was done by hand. Unlike plantations on upland which often have to be weeded or released 2 or 3 years after planting, no subsequent care was required by these trees.

An examination in October 1945, at the end of eight growing seasons, showed a survival averaging 68 percent, or about 1850 trees per acre. Moreover, these survivors averaged 44 inches in height (ranging from 16 to 87 inches). The shorter trees were found in the wetter areas. The examination brought out the fact that sphagnum moss is an excellent rooting medium due to its extreme porosity, large water-holding capacity, and good aeration.

The planting technique was a bit cumbersome, but could be improved by using a light short-handled hoe which would make a hole of the proper size and shape with one stroke. After setting the tree the displaced moss could be packed around the roots with a firming motion of the hands.

The favorable results obtained from this plantation suggest the advisability of further trials. Planting should be confined to the more productive areas, such as the swamp borders, avoiding the very wet swamps with deep peat.

July 1946

Eugene I. Roe, Silviculturist

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 8, MINNESOTA
No. 257

Aspen Suckers Can Produce Well-stocked Mature Stands

Young aspen stands which spring from root suckers after cutting often contain a high percentage of defective and diseased stems. This has fostered a common belief that such stands produce mostly cull trees. However, a recent study made on the Pike Bay Experimental Forest in northern Minnesota tends to disprove this.

Strips were clear cut through two typical young aspen stands of sucker origin. The trees were classified as to dominance and degree of defect with the following results:

Color of wood	Number of stems per acre									
	10-year-old stand --					22-year-old stand --				
	Dom.	Codom.	Int.	Supp.	Total	Dom.	Codom.	Int.	Supp.	Total
White 1/	876	967	370	...	2213	387	533	97	...	1017
Stained 2/	277	461	646	368	1752	243	437	776	144	1600
Brown 3/	...	...	371	464	835	...	48	290	145	483
Total	1153	1428	1387	832	4800	630	1018	1163	289	3100

1/ Absolutely sound.
2/ Incipient stage of decay (probably caused by Fomes igniarius).
3/ Medium stage of decay (probably caused by Fomes igniarius).
Only the white, absolutely sound stems are expected to make merchantable products.

The 10-year-old stand has 1843 sound dominant and codominant trees per acre, averaging about 2 inches d.b.h.; the 22-year-old stand has 920 averaging about 3-1/2 inches d.b.h. Allowing an ample margin for losses, both stands have enough stems in these classes to provide the 300 stems (all classes) per acre which a well-stocked 45-to 50-year-old stand should have in this locality.

July 1946

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 8, MINNESOTA
No. 258

The Area Reforested in the Lake States

Some 5,000,000 acres have been reforested in the United States; 20 percent of this has been in the three Lake States. The most accurate statistics on forest planting are those reported in connection with Section 4 of the Clarke-McNary law. Yet they are in some ways incomplete. The Clarke-McNary data for the three Lake States, supplemented by a search of original state and federal records, have been used as a basis for the record through 1944, shown in the table below. The figures given are considered reasonably accurate, but are subject to correction upon the basis of more complete data.

Although pure plantations are most common, mixtures of two or more species have been planted on 412,000 acres -- 301,000, in Michigan; 88,000, in Wisconsin; and 23,000, in Minnesota.

Cumulative Area Planted in Lake States Through 1944

Category	Federal	State	County, municipal	All public	Farmers	Other private	All private	Tot. all agencies
				Thousand acres				
				Michigan				
Net area planted	468	217	11	696	42	28	70	766
Area replanted	136	32	2	170	Data not available			
Area successful plantation	279	203	6	488	do			
				Wisconsin				
Net area planted	200	30	75	305	55	39	94	399
Area replanted	42	7	14	63	Data not available			
Area successful plantation	138	27	73	238	do			
				Minnesota				
Net area planted	101	37	2	140	85	3	88	228
Area replanted	21	4	1/	25	Data not available			
Area successful plantation	64	22	1	87	do			
				Lake States				
Net area planted	769	284	88	1141	182	70	252	1393
Area replanted	199	43	16	258	Data not available			
Area successful plantation	481	252	80	813	do			

1/ Less than 600 acres.

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Paul O. Rudolf, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 259

Jack Pine Regeneration Retarded by Rodents and Birds

That small rodents and seed-eating birds retard the reseeding of many trees is well known. The actual role played by different species of animals and birds, however, is known in a general way only. Specific information on the destruction of jack pine seeds by nine rodent species and five bird species was provided by a study made on the Chippewa National Forest, Minnesota, in 1941.

The study area had been logged, the ground disked, and cone-bearing jack pine slash scattered evenly over it. Abundant jack pine seeds were available. Flocks of Brewer blackbirds and goldfinches were present as well as smaller numbers of juncos and chipping sparrows. A few birds were shot and 161 small rodents were trapped on the area. An examination of their stomach contents gave the following results:

Occurrence of jack pine seeds in stomachs of small rodents and birds.

Species	No. of stomachs	Occurrence of: Jack pine seeds		Occurrence of: Other seeds	Occurrence of: Insects	Favored habitat: Forest	Favored habitat: Clearing
		Percent	Ave. No. per stom.	Percent	Percent		
Western chipmunk	88	72	31.0	96	69		x
Eastern chipmunk	9	11	.1	89	100	x	
Red squirrel	3	100	393.0	67	...	x	x
13-Lined squirrel	1	...	.....	100	100		x
White-footed mouse	30	70	19.0	45	100		x
Red-backed mouse	59	14	.6	61	39	x	
Meadow mouse	31	...	.....	23	6		x
Jumping mouse	1	...	.....	100	100	?	?
Long-tailed shrew	1	100	4.0	...	100	x	
Junco	4	100	3.0	75	100		x
Chipping sparrow	8	63	3.0	25	100		x
Goldfinch	8	100	21.0	25	12		x
Brewer blackbird	1	100	3.0	100	100		x
Ruffed grouse	1	...	.....	100	100		Border

Conclusions and suggestions derived from this study and other available information are: (1) Only a few birds and mammals seriously deplete the jack pine seed supply. (2) The species eating the most seed are those which thrive best and occur in the greatest numbers on cleared areas. (3) Direct seeding the first spring after fires or logging operations will insure the least destruction of seed by animals as well as a minimum of early vegetative competition. (4) Treat the seeds with a repellent mixture that will deter the birds and rodents. (5) Cover the seeds with mineral soil to help hide them from animals, hasten germination, and improve subsequent survival.

July 1946

Shaler E. Aldous, Biologist
U. S. Fish and Wildlife Service

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 260

Jack Pine Pole Supply in Minnesota

To help meet the heavy demand for poles, jack pine has recently been accepted for this use. However, the question has arisen as to how much jack pine is suitable for poles. Although the 1945 Forest Survey estimates show that there are some 977,000 acres of jack pine type in Minnesota, only 57 percent of it has stands which contain pole-size timber.

Early in 1946 data were collected on 18 plots distributed throughout the jack pine type of northern Minnesota to determine how much jack pine will meet the pole demand and specifications. This data correlated with Forest Survey stand tables and acreages shows the pole supply to be as follows:

Estimated number of jack pine poles in Minnesota 1/

D.B.H.	Approximate No. trees in merc. stands	Number of poles by lengths: 30	35	40+	Total
Inches		Thousands			
6	56,245	....	....	....	.....
8	23,770			2/	
10	10,430	3,155	2,352	230	5,737
12	4,175	143	975	1,260	2,378
14	1,335	44	169	414	627
16+	620			305	305
Total	96,575	3,342	3,496	2,209	9,047

1/ Only Class 7 poles 30 ft. and larger were considered in this estimate since this is the smallest size pole suitable for power line construction. A 30 ft. Class 7 pole must have a circumference of 25 in., 6 ft. from the butt, and must have a top circumference of 15 in.

2/ Only a very small percentage of 8-inch trees are suitable for 30 ft. poles, although they can provide a large supply of poles 25 ft. and smaller.

Under the present allowable cut for jack pine, 270,000 poles could be produced annually if all the timber cut meeting pole specifications were used for poles. With the heavy competition from pulpwood and lumber which in 1944 consumed 282,000 cords and 103 million bd.ft., respectively, it is estimated that the annual jack pine pole production in Minnesota will not exceed 100,000 pieces.

July 1946

Zigmond A. Zasada, Forest Economist

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 8, MINNESOTA

No. 261

Extended Periods of Seedfall of White Spruce and Balsam Fir

In forest management it is necessary to know when trees produce their seed. It has long been believed that seedfall of white spruce and balsam fir occurs soon after their cones ripen in late August and early September. But periodic examination of seed traps on the Superior National Forest in Minnesota during the heavy seed year, 1944, showed that seed dispersal from these conifers takes place over a much longer period -- in all probability through the winter months into the following season.

Seed collections were made at daily to 10-day intervals until mid-November, and thereafter not until the following May. There was a heavy catch of balsam and a light catch of white spruce seed in the May collection, indicating that seedfall of both species continued at least until the latter part of November and probably into the winter. The course of seed dispersal as brought out by the more or less periodic collections from two traps is given in the following table:

Proportion of total amount of seed produced which had fallen by various dates

Collection date	White spruce 1/	Balsam fir 2/
	Percent	Percent
August 23-31, 1944	0.9	1.3
September 16, 1944	7.0	10.0
September 22, 1944	22.0	26.0
October 5, 1944	35.0	32.0
October 13, 1944	49.0	43.0
October 19, 1944	79.0	49.0
October 26, 1944	87.0	56.0
November 6, 1944	93.0	61.0
November 17, 1944	93.5	62.0
May 29, 1945	99.9	99.9
June 18, 1945	100.0	100.0
July 18, 1945	100.0	100.0

1/ Basis 867 seeds. 2/ Basis 2,695 seeds.

It will be noted that whereas about 7/8 of the white spruce had fallen by late October, only a little over half of the balsam fir seed had been shed by this time. Most of the balsam seed still remaining on the trees, or more than one-third of the total amount produced, fell sometime between mid-November and spring. Seedfall of both species was completed by mid-June.

October 1946

E. I. Roe, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 8, MINNESOTA
No. 262

Valuable Products Can Be Recovered From No. 2 and Poorer Logs

At the Upper Peninsula Experimental Forest, Dukes, Michigan, the top grade logs are sold for veneer and woodenware. The No. 2 and poorer logs commonly are sawed by small circular mills for lumber. In order to obtain data on grade recovery of use in evaluating timber, records were kept in 1945 of 105 M feet of No. 2 and poorer logs cut on the forest and sawed by a small local mill. A summary of results is given below:

Percent of log material scaled (Scribner Dec. C) by species

Logs					Tie cuts	Total percent
Sugar maple	Yellow birch	Black ash	Other hdwds.	Total	Mixed hdwds.	
43.8	11.9	13.3	9.2	78.2	21.8	100

Recovery from mill

Lumber

Species	Logs scaled	Percent by grade						
		FAS	Selects	No. 1C	No. 2C	No. 3C	Hearts 4x4"	Total
	Bd.ft.							
Sugar maple	38,609	3.7	5.1	25.6	34.8	30.8		100.0
Yellow birch	10,233	7.8	7.2	20.2	30.9	33.9		100.0
Black ash	10,107	7.0	6.9	18.7	17.3	50.1		100.0
Other hdwds.	9,600	4.0	2.1	30.0	30.4	33.5		100.0
Mixed hdwds.	4,382	...	...	....	....	....	100.0	100.0
Total	72,931	4.6	4.9	22.9	29.2	32.4	6.0	100.0

Ties

Species	Length feet	Total No.	Percent by grade						
			No. 5	No. 4	No. 3	No. 2	No. 1	U.R.	Total
Maple, birch and beech	8.0	838	20.9	29.3	33.2	5.6	6.0	5.0	100.0
Do	8.5	251	31.4	26.3	29.1	4.8	4.8	3.6	100.0
Elm	8.0	54	38.9	22.2	27.8	0	7.4	3.7	100.0
Total 1/		1,143	24.1	28.3	32.0	5.2	5.8	4.6	100.0

1/ 34,290 bd.ft.

Slabs (chemical wood): 89.25 cords (342,300 pounds)

The operations from which the above logs were taken also produced during the same period 46,450 bd.ft. of veneer logs, 9,098 linear feet (27,294 bd.ft.) of mine timbers and 765 cords of chemical wood. Heavy wartime demand with its lowered standards of acceptance is undoubtedly reflected in the product and grade proportions shown. The summary does illustrate, however, the recovery possible from the worst trees in defective old-growth hardwood stands by careful cutting and complete utilization.

October 1946

W. M. Zillgitt, Silviculturist
W A. Salminen, Timber Management Asst.

INTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 8, MINNESOTA
No. 263

Thinning Young Aspen Can Pay

In 1936 a series of thinning plots was established in a 13-year old aspen stand on the Pike Bay Experimental Forest in northern Minnesota, on a good site. The purpose was to determine if aspen products could be improved by thinning. The plots were remeasured in 1945 at the age of 23, with the results shown below:

Results per acre of thinning young aspen to various spacings

Spacings	After thinning 1936 (age 13)				1945 (age 23)				
	No. trees	Ave. d.b.h.	Basal area	Volume	No. trees	Ave. d.b.h.	Basal area	Volume	
		Inches	Sq.ft.	Cu.ft.		Inches	Sq.ft.	Cu.ft.	Cords 1/
Check	3633	1.6	53.9	610	1333	3.0	66.7	1257	7.37
5x5'	1717	1.8	30.3	372	1383	3.2	77.8	1479	10.50
6x6'	1217	1.8	21.4	258	1075	3.6	77.9	1559	12.81
7x7'	975	1.9	18.9	242	933	3.9	78.1	1559	15.87
8x9'	545	2.2	14.3	190	512	4.9	66.9	1320	17.49
10x11'	396	2.1	9.6	128	359	4.8	44.9	887	11.38

1/ Cords computed to 3" top, inside bark.

Young aspen, according to this experiment, responds to thinning almost in direct relation to increased spacings up to 8 ft. by 9 ft. If clear cut for pulpwood at this early stage, the 7 ft. by 7 ft. and the 8 ft. by 9 ft. spacings would already have paid for the thinning cost. Quality more than quantity, however, should be the objective in aspen management on good soils. Because of their thriftiness, the trees in the spacings from 7 ft. by 7 ft. and greater may be expected to continue to grow at this rapid rate and thus in a comparatively short time develop products of higher grade.

The 7 ft. by 7 ft. and 8 ft. by 9 ft. spacings offer the best possibilities for management. A commercial thinning which removed 4-1/2 cords of pulpwood per acre in the spring of 1946 has left these stands in excellent condition for continuous rapid growth. The products thus harvested help substantially in paying for the first non-commercial thinning.

October 1946

Paul J. Zehngraff, Silviculturist

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 8, MINNESOTA

No. 264

A Simple Accurate Scale Board for Small Sawmills

Poorly sawed lumber is often produced by small sawmills partly because they use scale boards or rulers which are difficult to read accurately. Described here is a new scale board which will improve milling accuracy for three reasons: (1) The marks indicating an inch travel of the knee are actually two inches apart on the scale board; (2) The scale board faces the sawyer at eye level; (3) Sawdust and dirt do not accumulate on the vertical scale.

A sawmill operator can construct this scale board inexpensively from his own lumber and hardware easy to obtain as follows (see sketch on reverse): (1) Make a base board (A) from a surfaced 2x4 from 5 to 6 feet long. (2) Fit a sliding box (B) around the 2x4 so it will move freely up and down. Make the side runners from surfaced one-inch stock. They should be at least 10 to 12 inches long and slightly wider than the thickness of the 2x4. With stove bolts fasten a face plate and back plate of galvanized sheet metal to the side runners to form the box. (3) Place two narrow tin runners (C) under the sides of the face plate to prevent it from scratching the ruler on the center of the 2x4. (4) Bend the top and bottom of the face plate and back plate outward (D) to prevent catching on the 2x4. (5) Install two window sash pulleys on the base board as shown in front and rear views. Cut the bottom sash pulley into the side of the 2x4 about two inches above the top of the bunks of the headblock. Attach the top pulley with two small pieces of angle iron (E). (6) Push the sliding box up to the top of the board until it hits the top pulley. (7) In this position draw a line immediately under the wire pointer (F) to indicate the zero line. (8) Remove or push the box to the bottom out of way and draw the index ruler on the center of the 2x4. This can be done by temporarily clamping a yard stick to the base board and transferring the marks to the board. The marks indicating one inch travel of the knee are spaced two inches apart on the board. Additional marks indicating 1/2, 1/4, 1/8, and even 1/16 inch travel of the knee may be added. (9) Install a fine aerial cable or furnace chain as diagrammed. Where the end of the cable is attached to the 2x4 install a small turnbuckle to make fine adjustments. The awning pulley (G) should be straight in front of the lower sash pulley and level with the cable entrance. If this precaution is not observed the index pointer will not remain accurate when it moves up and down. (10) Attach a weight of lead or iron to the sliding box to keep the cable tight.

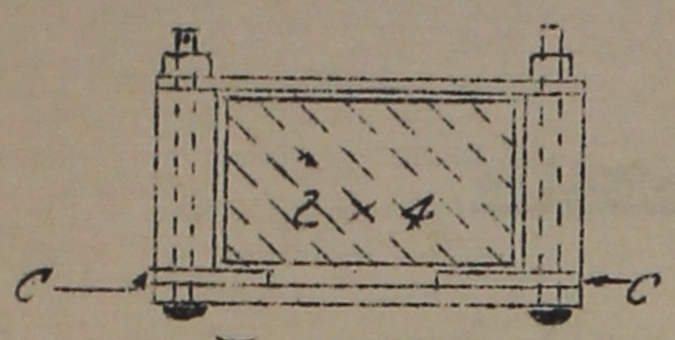
More complete scale boards are described in the Michigan Agricultural Experiment Station Quarterly Bulletin for February 1946, and the Forest Products Laboratory mimeographed Bulletin R899-18.

October 1946

Richard C. Johnson, Agent

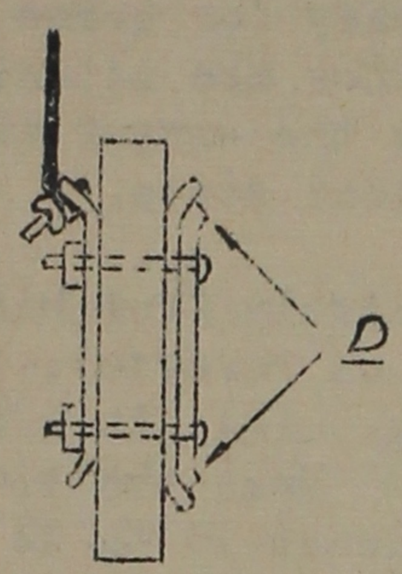
MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

SCALE BOARD

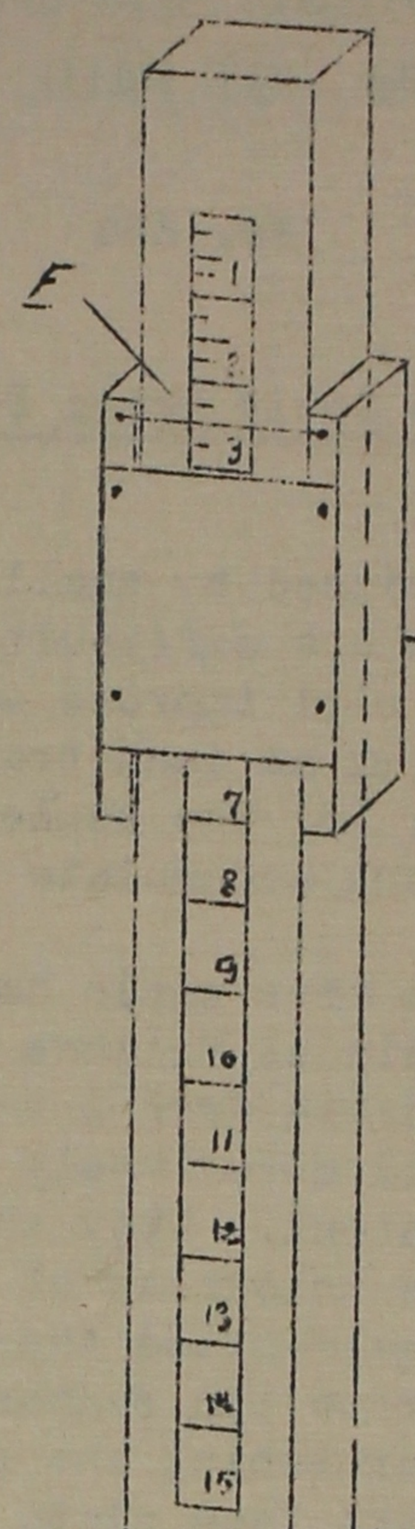


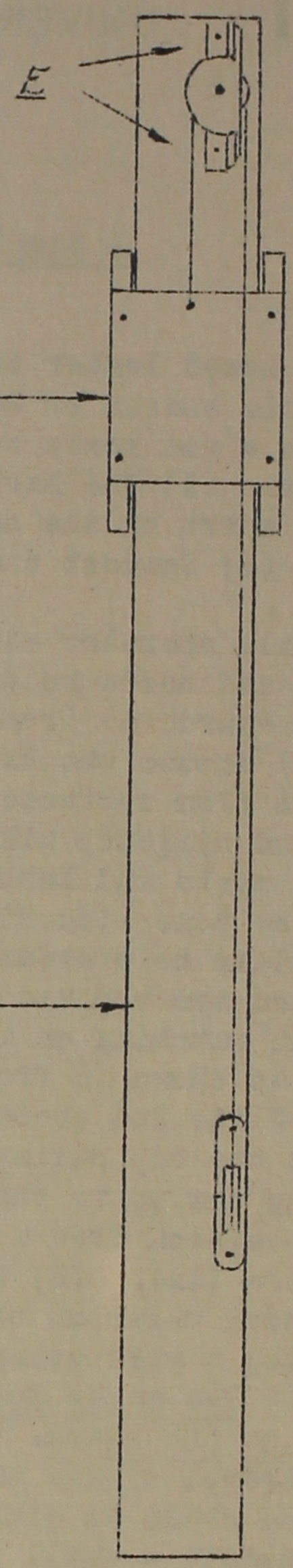
BOX DETAIL

TOP VIEW

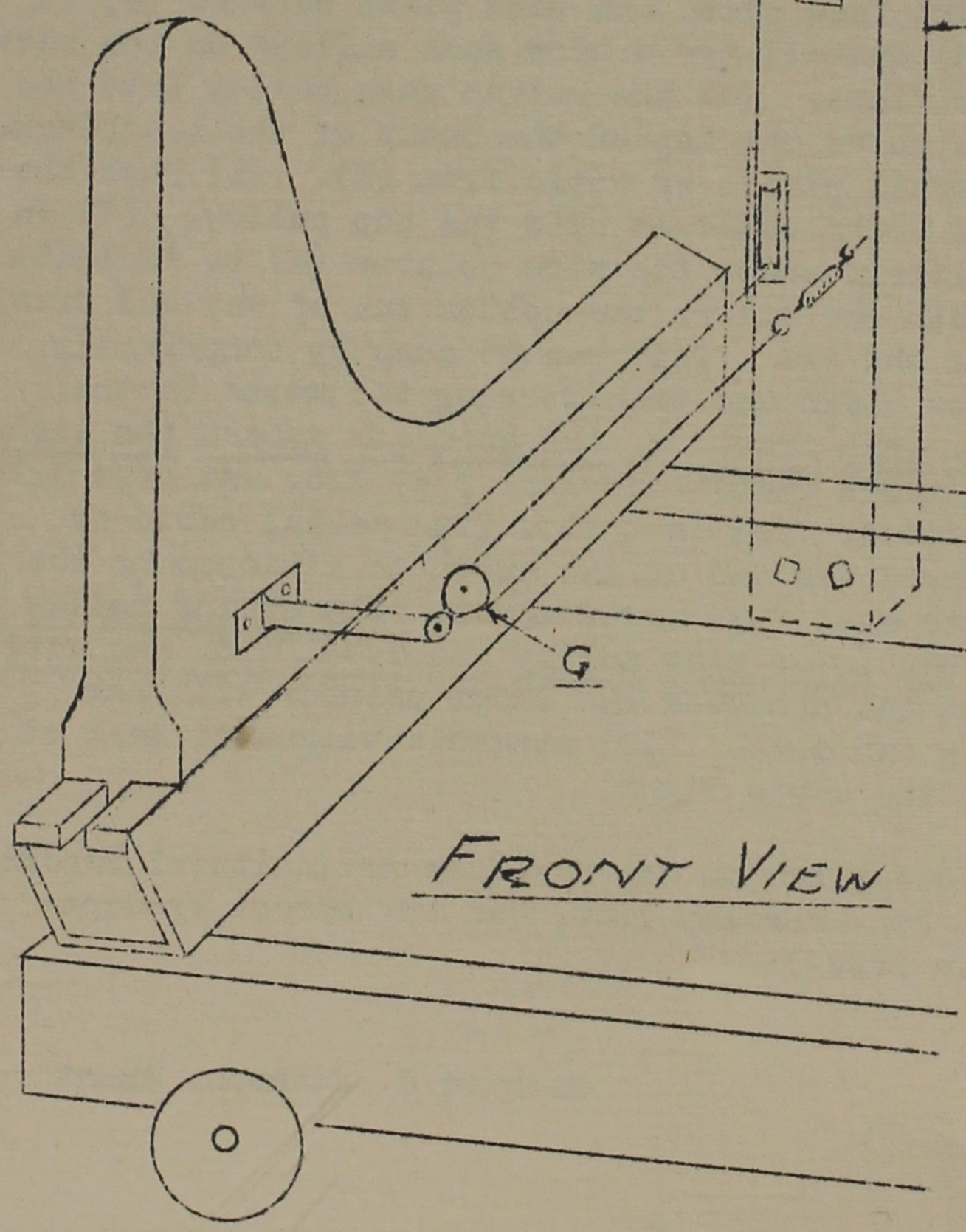


SIDE VIEW





REAR VIEW



FRONT VIEW

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 8, MINNESOTA

No. 265

Tree Species Planted in the Lake States

Over 1-1/3 million acres have been reforested in the three Lake States. The proportion of this area planted by different classes of owners in each of the states was shown in Technical Note No. 258. It is important to know what kinds of trees -- as well as how many acres -- have been planted. The number of trees by major species planted through 1944 by public agencies is shown for each state and the Lake States region in the table on the reverse of this sheet. No information is presented for planting by private agencies because reasonably complete data could not be obtained. Since public owners have planted about 82 percent of the net area reforested in the region, the proportion of the various species shown in the table probably would change only very little if complete data were available.

About 11 percent of all the trees planted were transplants. The percentage by species is jack pine, 1; red pine, 15; white pine, 19; other pine, 13; white spruce, 52; other spruces, 13; other conifers, 13; and hardwoods, 2.

October 1946

Paul O. Rudolf, Silviculturist

AINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Cumulative Number of Trees Planted in the Lake States through 1944

State	Species	Federal	State	County and municipal	All public agencies
		In thousands of trees			
Michigan	Jack pine	199,388	76,427	1,296	277,111
	Red pine	209,328	88,935	7,469	305,732
	White pine	24,909	31,958	3,606	60,473
	Other pine 1/	5/	.....	.....	.....
	White spruce	14,867	.....	.....	14,867
	Other spruces 2/	5/	.....	.....	.....
	Other conifers 3/	3,180	1,760	10	4,950
	Hardwoods 4/	1,098	7,571	265	8,934
	Total	452,770	206,651	12,646	672,067
Wisconsin	Jack pine	75,954	16,199	46,751	138,904
	Red pine	79,032	18,243	34,065	131,340
	White pine	13,586	4,829	8,143	26,558
	Other pine 1/	5/	882	640	1,522
	White spruce	18,131	491	1,551	20,173
	Other spruces 2/	5/	1,376	5,670	7,046
	Other conifers 3/	10,274	11	37	10,322
	Hardwoods 4/	530	68	314	912
	Total	197,507	42,099	97,171	336,777
Minnesota	Jack pine	44,246	10,036	512	54,794
	Red pine	43,697	16,918	412	61,027
	White pine	12,987	6,146	86	19,219
	Other pine 1/	5/	.....	.....	.....
	White spruce	6,087	5,810	292	12,189
	Other spruces 2/	5/	89	2	91
	Other conifers 3/	311	373	38	722
	Hardwoods 4/	.....	98	66	164
	Total	107,328	39,470	1,408	148,206
Total Lake States	Jack pine	319,588	102,662	48,559	470,809
	Red pine	332,057	124,096	41,946	498,099
	White pine	51,482	42,933	11,835	106,250
	Other pine 1/	1,875	882	640	3,397
	White spruce	39,085	6,301	1,843	47,229
	Other spruces 2/	9,140	1,765	5,672	16,577
	Other conifers 3/	2,750	2,144	85	4,979
	Hardwoods 4/	1,628	7,437	645	9,710
	Total	757,605	288,220	111,225	1,157,050

1/ Includes chiefly Scotch pine, Austrian pine, and ponderosa pine.
2/ Includes chiefly Norway spruce and black spruce.
3/ Includes a variety of species, such as European larch, tamarack, northern white cedar, eastern red cedar, balsam fir, and Douglas fir.
4/ Includes a large variety of species planted for wood production, wildlife, and erosion purposes.
5/ Under "Federal" for the individual states, "other pine" and "other spruces" are included with "other conifers."

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST.PAUL 8, MINNESOTA
No. 266

Taper Table For Aspen (Populus tremuloides) - Well-stocked Stands

Lake States

How many logs or bolts of different diameters can be cut from trees of different sizes under various utilization practices? How can different parts of a tree be scaled in different units of volume? For aspen, the taper table below, which shows the diameter inside bark at regular intervals above the ground, can be used.

D.b.h. o.b.	Total ht.	Stem diameter inside bark at height above ground of - 1 foot	9 feet	17 feet	25 feet	33 feet	41 feet	49 feet	57 feet	65 feet	73 feet	81 feet	Basis Trees
Inches	Feet	Inches											
4	30	4.2	3.3	2.7	1.5								43
	40	4.1	3.4	3.1	2.5	1.3							62
	50	4.0	3.5	3.2	2.8	2.1	1.2						20
5	30	5.2	4.2	3.3	1.9								...
	40	5.1	4.3	3.9	3.0	1.6							20
	50	5.0	4.4	3.9	3.4	2.6	1.5						67
	60	5.0	4.5	4.2	3.8	3.3	2.6	1.7					16
6	30	6.2	5.1	4.0	2.2								...
	40	6.1	5.2	4.6	3.5	1.9							4
	50	6.0	5.2	4.7	4.0	3.1	1.8						26
	60	6.0	5.3	5.0	4.5	3.9	3.1	2.0					47
7	30	7.2	5.9	4.6	2.5								...
	40	7.1	6.0	5.3	4.0	2.1							...
	50	7.0	6.1	5.4	4.7	3.6	2.1						7
	60	7.0	6.2	5.7	5.1	4.5	3.6	2.3					27
	70	7.0	6.3	6.1	5.7	5.3	4.5	3.5	2.3				20
8	40	8.1	6.9	5.9	4.4	2.4							...
	50	8.1	6.9	6.1	5.2	4.0	2.4						1
	60	8.0	7.1	6.5	5.8	5.0	4.0	2.7					19
	70	8.0	7.3	6.8	6.4	5.7	4.9	3.8	2.5				32
	80	8.0	7.4	7.1	6.7	6.2	5.5	4.6	3.6	2.6			6
9	40	9.2	7.7	6.4	4.8	2.6							...
	50	9.1	7.7	6.9	5.9	4.5	2.7						...
	60	9.1	7.9	7.2	6.5	5.6	4.4	2.9					5
	70	9.1	8.0	7.5	7.0	6.2	5.3	4.2	2.8	1.1			20
	80	9.1	8.1	7.8	7.3	6.8	6.0	5.0	4.1	2.9			19

January 1947

S. R. Gevorkiantz, Silviculturist

(Over)

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

D.b.h. o.b.	Total ht.	Stem diameter inside bark at height above ground of - 1 foot	9 feet	17 feet	25 feet	33 feet	41 feet	49 feet	57 feet	65 feet	73 feet	81 feet	Basis Trees
Inches	Feet	Inches											
10	50	10.2	8.6	7.6	6.4	4.9	2.9						...
	60	10.2	8.7	8.0	7.2	6.1	4.9	3.2					4
	70	10.2	8.8	8.2	7.6	6.7	5.8	4.6	3.1	1.2			13
	80	10.2	8.9	8.5	7.9	7.4	6.5	5.5	4.5	3.2	1.5		22
11	50	11.3	9.4	8.3	7.0	5.2	3.1						...
	60	11.3	9.6	8.7	7.8	6.7	5.3	3.5					1
	70	11.3	9.6	8.9	8.2	7.2	6.2	5.0	3.3	1.4			7
	80	11.3	9.7	9.2	8.6	8.0	7.0	6.0	4.9	3.6	1.6		21
12	50	12.4	10.1	8.9	7.5	5.6	3.3						...
	60	12.4	10.4	9.5	8.4	7.2	5.7	3.8					...
	70	12.4	10.5	9.6	8.8	7.8	6.6	5.3	3.6	1.5			8
	80	12.4	10.5	9.9	9.2	8.6	7.6	6.5	5.3	3.9	1.7		15
	90	12.4	10.6	10.1	9.6	9.0	8.3	7.4	6.5	5.4	4.0		12
13	60	13.6	11.2	10.2	9.0	7.7	6.0	3.9					...
	70	13.6	11.3	10.3	9.4	8.3	7.1	5.7	3.8	1.6			1
	80	13.6	11.4	10.7	9.9	9.2	8.1	7.0	5.7	4.2	1.8		8
	90	13.6	11.5	10.9	10.3	9.6	8.8	7.9	6.9	5.8	4.3		4
14	60	14.8	12.0	10.8	9.6	8.1	6.4	4.2	1.4				...
	70	14.8	12.1	11.0	10.0	8.9	7.6	6.1	4.1	1.7			1
	80	14.8	12.3	11.5	10.6	9.8	8.6	7.5	6.2	4.5	2.0		5
	90	14.8	12.4	11.7	11.0	10.3	9.4	8.4	7.4	6.1	4.5	2.6	18
15	60	16.0	12.8	11.5	10.1	8.6	6.7	4.4	1.5				...
	70	16.0	13.0	11.8	10.6	9.4	8.0	6.4	4.3	1.8			1
	80	16.0	13.1	12.2	11.3	10.4	9.2	8.0	6.6	4.8	2.1		3
	90	16.0	13.3	12.5	11.8	11.0	10.0	9.0	7.8	6.5	4.8	2.8	2
16	60	17.3	13.6	12.1	10.6	9.0	7.0	4.6	1.6				...
	70	17.3	13.8	12.5	11.3	10.0	8.5	6.8	4.5	1.9			...
	80	17.3	14.0	13.0	11.9	11.0	9.8	8.5	7.0	5.1	2.3		2
	90	17.3	14.2	13.3	12.5	11.6	10.6	9.5	8.3	6.9	5.1	3.0	5
17	60	18.5	14.3	12.7	11.2	9.4	7.3	4.7	1.6				...
	70	18.5	14.7	13.3	12.0	10.5	8.9	7.1	4.8	1.9			...
	80	18.5	14.9	13.8	12.6	11.6	10.4	9.1	7.5	5.4	2.4		1
	90	18.5	15.0	14.1	13.3	12.3	11.2	10.1	8.8	7.2	5.4	3.2	...
18	60	19.8	15.1	13.3	11.7	9.8	7.6	4.8	1.7				...
	70	19.8	15.5	14.0	12.6	11.1	9.4	7.4	5.0	2.0			1
	80	19.8	15.8	14.6	13.4	12.3	10.9	9.6	7.9	5.7	2.6		1
	90	19.8	15.9	15.0	14.0	13.0	11.8	10.7	9.2	7.6	5.7	3.4	2
													619

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No. 267

Lead Indicating Device for Circular Saw Mill Headrigs

The instruments and the methods used for measuring lead of a saw are very crude. Furthermore, the common rule of 1/8 inch lead to 20 feet of track is arbitrary. A saw even if accurately set does not necessarily function best at 1/8 inch lead. The proper lead for a saw is the point at which it runs the best.

To assist mill operators in making lead adjustments an indicator can be made as follows:

(1) Make guide pins of wood or red fiber insulation board.
(2) Drill a hole about 1/2 inch diameter through the length of the pin.
(3) Fit a tin form around the pin to extend a quarter inch past the saw end of the pin.
(4) Stand the pin on end - saw end up - and pour babbitt. The pin then has full babbitt contact with the saw and yet is insulated from the guide holder.
(5) Mount ordinary truck clearance lights in a spot convenient for the sawyer to watch, and complete the circuits with insulated wire as diagrammed on the back of this sheet.

If the circuits become sluggish, slip a piece of emery cloth between the saw and pin and rub off dirt accumulation from the babbitt tip. Relatively sudden changes in indication may be caused by looseness in one of the guides which should be checked for adjustment before altering the lead. The guide pins should be clear of the free-running blade by equal amounts, preferably between 1/64 or 1/32 of an inch. If a saw is untrue and flutters, the lights will flicker, but when the saw enters the cut it steadies down materially so the indicator functions properly. If the saw has burrs or rough spots in the area which contacts the pins, use emery cloth to remove the burrs to prevent roughing the babbitt face of the pins. Do not use oil lubricants since they act as an insulator and prevent completion of the circuits.

A saw with improper lead will be forced against the pin toward which the saw is leading. Ordinarily it is difficult to see which pin a saw is rubbing in a cut. However, with this device, when the saw touches a guide pin it closes a circuit and illuminates the light in that pin circuit. Thus it shows where the saw is in relation to the pins at all times. It indicates lead errors much sooner than a sawyer can judge them by observation of the saw alone. If lead is about correct the saw may not light either light as it goes through a cut or it may alternately light one and then the other indicating that at no time is the saw forced much out of line. If the saw crowds one pin consistently in a cut the light indicates in which direction the lead is in error.

In addition to being helpful in adjusting lead, this device may be useful in making further studies of saw behavior. In initial tests it has shown that lead requirements vary by species, particularly between hardwoods and softwoods.

January 1947 Richard C. Johnson, Agent

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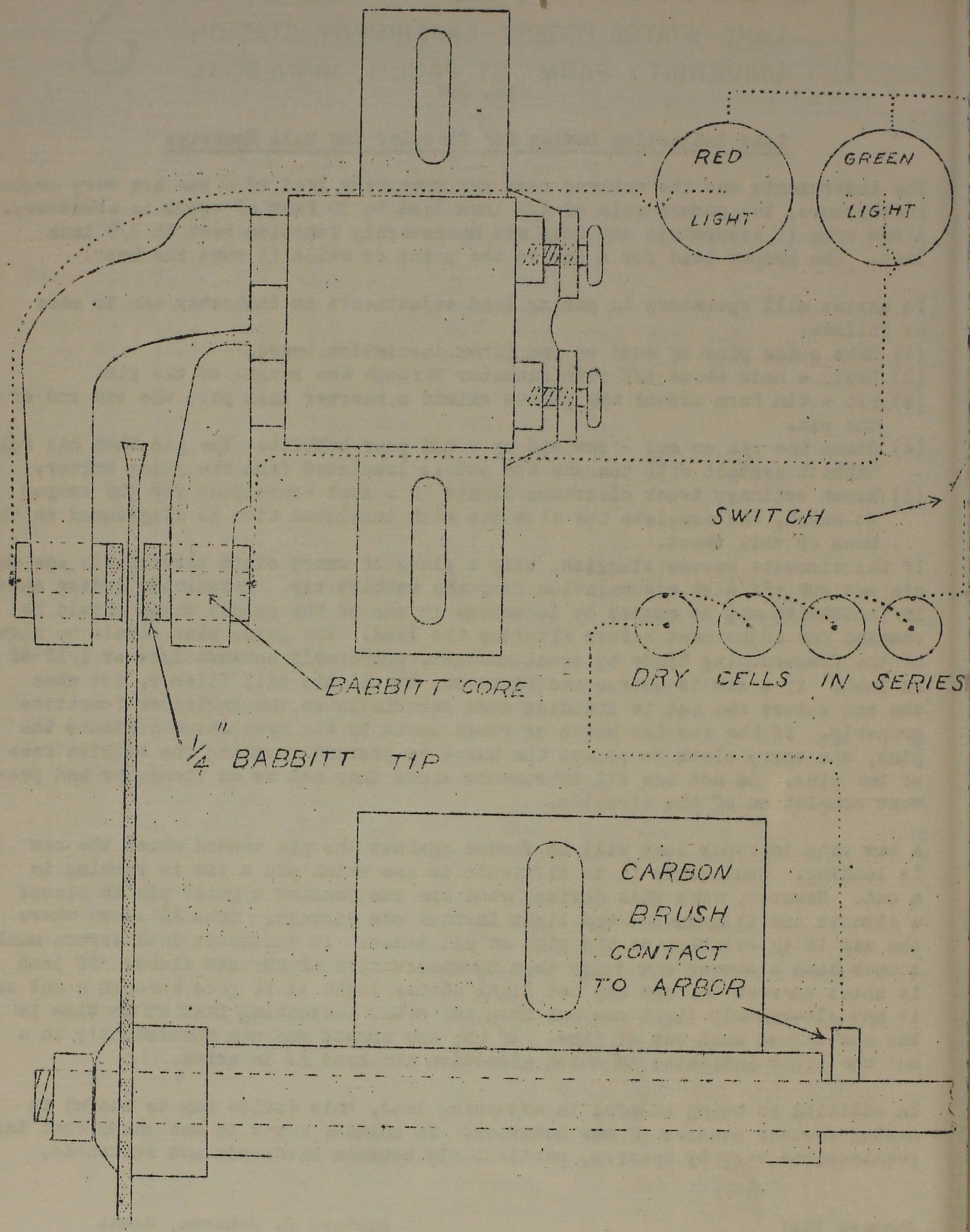
LEAD INDICATOR



RICHARD C. JOHNSON

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
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No. 268

Yield Table for Cottonwood Plantations

Planted cottonwood in north central North Dakota grows remarkably well according to yield studies made by the Lake States Forest Experiment Station. It grew at an average rate of 1.38 cords or 314 board feet per acre per year for 50 years. Because of its rapid growth and its usefulness for farm construction, farmers should consider planting of cottonwood. Subirrigated sandy soils with a permanent water table at 4 to 12 feet below the surface, or overflow lands along creeks and rivers where moisture conditions are favorable are preferred sites.

Yield table for cottonwood plantations in McHenry County, North Dakota - 1935

Age	Average stand diameter	Average total height	Values per acre: Trees	Total basal area	Cubic volume: Total	Cubic volume: Merch.	Cords	Scrib. volume
Yrs.	Inches	Feet	Number	Sq. ft. (1)	Cu.ft. (2)	Cu.ft. (3)	(4)	Bd. ft. (5)
10	1.5	18	1,000	12	130	...	...	...
20	5.1	38	634	90	1,200	370	5.7	...
30	8.4	56	415	160	2,720	2,280	35.0	4,250
40	10.4	69	327	193	3,900	3,700	57.0	11,800
50	11.6	78	277	204	4,690	4,500	69.0	15,700

Basis: 16 plots representing successfully established cottonwood plantations in Valentine fine sands, Sioux sandy loam, and Barnes very fine sandy loam soils. All volumes are gross; no deductions for cull or defect were made.

(1) Cross-sectional area at breast height of all trees, 1 inch and larger in diameter.
(2) Total peeled volume (stump, stem, and top) of trees 1 inch and larger in diameter.
(3) Merchantable peeled volume (stem above a 1-foot stump to a 4-inch top diameter inside bark) of trees 6 inches and larger in diameter.
(4) The same merchantable volume as in (3) expressed in standard cords 4x4x8 feet. Cords represent piles of unpeeled wood.
(5) Merchantable volume in board feet, Scribner (stem above a 1-foot stump to a top diameter of 6 inches inside of bark) of trees 10 inches and larger in diameter.

January 1947

J. H. Stoeckeler, Forester

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No. 269

How Many Small Fence Posts to a Cord?

The wood and steel shortage during the war necessitated the use of large numbers of small untreated fence posts on mid-western farms. Many of these were cut from less durable local tree species of sapling age. Although such posts deteriorate rapidly if untreated, they can be made quite durable by treatment with preservatives. Because of the continuous need for fence posts, the use of such small material will probably continue. In anticipation of increased future demands for treated small posts of local origin, a measurement study was recently conducted in young stands in northern Minnesota to determine the average number of posts in a cord. The table below shows the number of 6-, 7-, and 8-foot posts per cord of small sized aspen and pine.

Top diameter inside bark	Number of unpeeled posts per standard cord					
	Aspen			Pine		
	6-foot	7-foot	8-foot	6-foot	7-foot	8-foot
Inches	Number	Number	Number	Number	Number	Number
1.6 - 2.5	...	...	...	281	241	211
2.0 - 2.5	253	218	190	248	212	186
2.6 - 3.5	200	171	150	203	174	152
3.6 - 4.0 1/	156	135	117	147	126	110
3.6 - 4.5	...	...	...	136	116	102 2/

1/ 4.0 inch top, inside bark, is the present minimum diameter acceptable for aspen pulpwood.

2/ This number is somewhat higher than that shown in Technical Note No. 197 because the posts are straighter than average pulpwood and most of the posts were taken from the entire tree whereas the ordinary run of pulpwood contains many sticks from the top ends of larger trees.

January 1947

Paul J. Zehngraff, Silviculturist

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TECHNICAL NOTES
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No. 270

Second Growth Woodland on Farms Can Return an Annual Income

Most farms in northern Michigan contain some woodland. That such lands properly managed may yield substantial annual returns is borne out by the results obtained on a sample 40-acre woodlot, which was established on the Upper Michigan Experimental Forest, at Dukes, Michigan in 1946.

This tract of second growth hardwoods, logged-over 35 to 40 years ago, was divided into five compartments of 8 acres each. Compartment No. 1 from which the data below were obtained was given an improvement cutting in 1946 and the estimated equivalent in annual growth of the entire woodlot was removed. In each succeeding year one compartment will be cut.

Based on 40 tenth-acre growth plots, this woodlot had a volume per acre of 10.4 cords in trees 5-9 inches d.b.h. and 4,101 board feet gross in trees 10 inches d.b.h. and larger. Annual growth per acre for the smaller trees was .14 cords and for the larger trees 212 board feet gross.

Volumes and values of products cut in 1946 were as follows:

Returns from 1946 Cutting - Compartment No. 1 (8 acres) 1/

Product	Net volume removed 2/ on 8 acres	Net volume removed 2/ on 1 acre	Value at roadside - 8 acres
Saw logs (woods run)	4,350 bd.ft.	544 bd.ft.	$ 134.28
Chemical bolts	13.2 cds. (36.3 tons)	1.6 cds. (4.5 tons)	89.10
Cordwood	6.3 cds.	.8 cds.	50.40
Pulpwood	3.4 cds.	.4 cds.	39.95
Fuelwood 3/	2.0 cds.	.2 cds.	.....
Total			$ 313.73

1/ Includes salvage material: 750 bd.ft. of sawlogs, 1.1 cds. of chemical bolts, 4.4 cds. of cordwood, and 0.2 cds. of pulpwood.
2/ Gross volume was approximately double net volume because the poorest material was removed.
3/ Salvaged from unmerchantable dead trees under 5 inches d.b.h.

After deducting a skidding cost of $59.40 there remained a net return of $254.33 for 208 hours of labor. Although the stumpage value of the products removed in the 1946 cutting was only $30, the operator earned $1.22 per hour in logging Compartment No. 1. This demonstrates the financial advantage to the owner in doing his own logging.

January 1947 W. M. Zillgitt, Silviculturist

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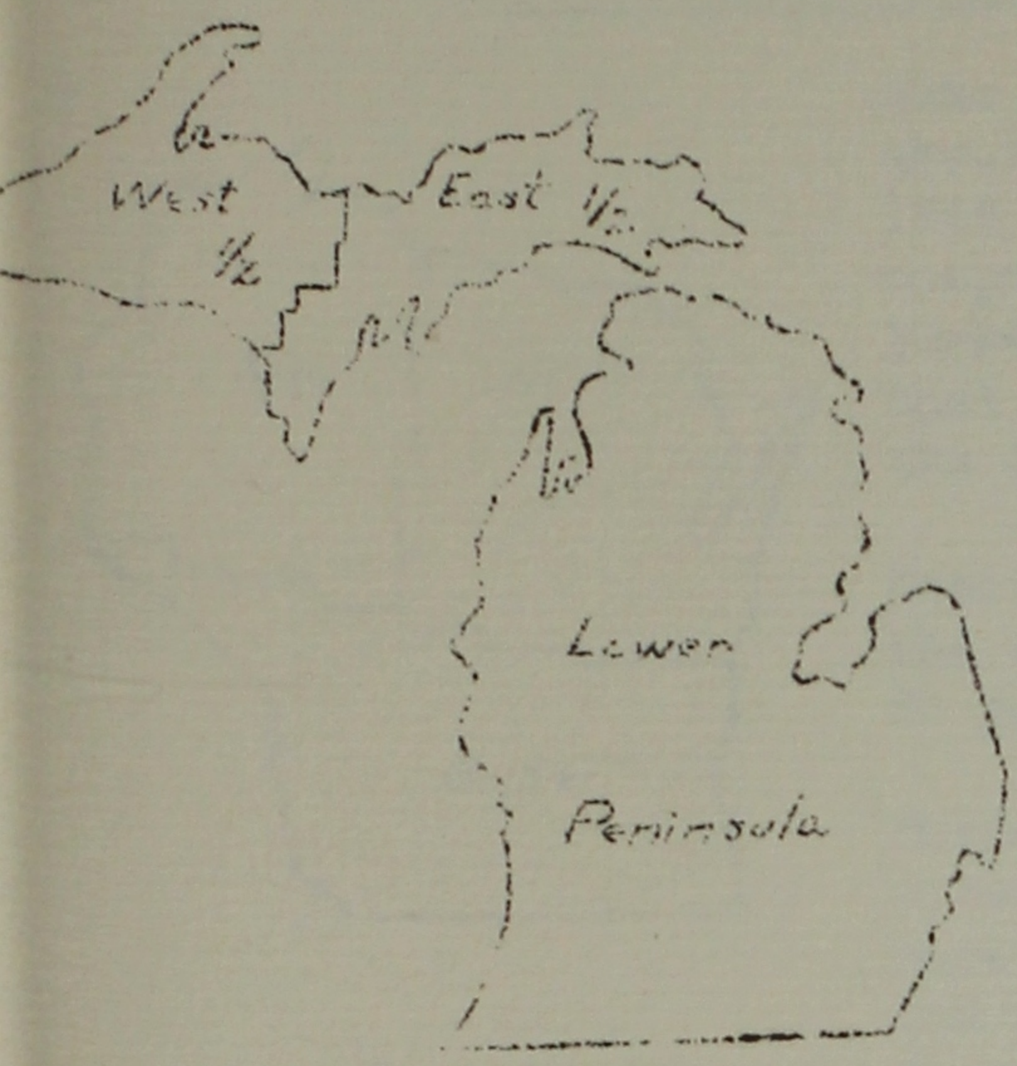
No. 271

1946 Michigan Lumber Production Continues at High Level



Some 1,100 active sawmills in Michigan produced about 595 million bd. ft. of lumber and ties in 1946 -- almost half of the total output for the Lake States. The average for the 10 years, 1936-1945, was 445 million bd. ft.

About 74 percent of the state total, 442 million bd. ft., was produced in the Upper Peninsula.

These are preliminary estimates based upon monthly surveys made for the WPB and CPA by the Lake States Forest Experiment Station with some assistance from the Northern Hemlock and Hardwood Manufacturers Association.

Strong markets and a more adequate labor supply were largely responsible for stimulating production in 1946.

Species	Geographic units: Western half, Upper Peninsula	Geographic units: Eastern half, Upper Peninsula	Geographic units: Lower Peninsula	Total Michigan
	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.
Ash	4,176	570	2,492	7,238
Aspen	7,353	9,512	9,767	26,632
Basswood	7,692	1,179	8,002	16,873
Beech	3,621	11,679	13,270	28,570
Birch	46,060	15,278	268	61,606
Cherry	4	4	549	557
Cottonwood	11	.....	1,879	1,890
Elm	9,007	1,557	20,336	30,900
Hickory	.....	.....	379	379
Maple	136,528	35,326	33,747	205,601
Oak	1,935	167	25,091	27,193
Walnut	.....	.....	449	449
Other hardwoods	879	426	4,875	6,180
Total hardwoods	217,266	75,698	121,104	414,068
Hemlock	81,463	36,423	5,934	123,820
White pine	7,398	10,549	5,086	23,033
Other pine	3,440	3,126	18,214	24,780
Spruce	3,832	1,008	550	5,390
Other softwoods	1,147	1,055	1,293	3,495
Total softwoods	97,280	52,161	31,077	180,518
All species	314,546	127,859	152,181	594,586

Note: Production data include all mill classes.

April 1947

Lucille P. Olsen, Statistician

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 272

Wisconsin Lumber Production Increased in 1946

Some 1,000 active sawmills in Wisconsin produced about 409 million bd. ft. of lumber and ties in 1946 which represent about one-third of the total output for the Lake States. The total volume of lumber produced in 1946 was 29 percent greater than that of the previous year; however, it was less than the 1936-1945 10-year average of 433 million bd. ft.

Heaviest production was in the northeastern part of the state where some 218 million bd.ft. -- about 53 percent of the state total -- were produced.

These are preliminary estimates based upon monthly surveys made for the WPB and CPA by the Lake States Forest Experiment Station with the assistance of the Northern Hemlock and Hardwood Manufacturers Association.

Species	Geographic units			Total
	Northeast	Northwest	South	Wisconsin
	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.
Ash	4,097	2,263	634	6,994
Aspen	31,013	22,339	3,984	57,336
Basswood	10,373	7,632	6,001	24,006
Beech	937	6	55	998
Birch	19,864	5,048	154	25,066
Cherry	35	.....	42	77
Cottonwood	483	24	901	1,408
Elm	14,073	5,474	3,238	22,785
Hickory	.....	.....	47	47
Maple	49,286	12,053	10,950	72,289
Oak	8,969	8,705	37,004	54,678
Walnut	78	.....	65	143
Other hardwoods	2,888	148	397	3,433
Total hardwoods	142,096	63,692	63,472	269,260
Hemlock	45,072	31,135	201	76,408
White pine	13,914	14,244	1,282	29,440
Other pine	12,815	13,838	2,338	28,991
Spruce	757	121	37	915
Other softwoods	3,201	356	200	3,757
Total softwoods	75,759	59,694	4,058	139,511
All species	217,855	123,386	67,530	408,771

Note: Production data include all mill classes.

April 1947

Lucille P. Olsen, Statistician

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No. 274

Pulpwood Volume Increased by Closer Utilization

The heavy demand for pulpwood during recent years has established the practice of using trees to smaller top diameters. This makes existing volume tables too conservative. However, adjustments can be made to fit the tables to the new standards of utilization, as illustrated below. The table indicates the additional volume of pulpwood attained when utilization is changed from a 4-inch to a 3-inch top diameter inside bark. It applies to all pulpwood species in the Lake States.

Percent of additional volume of pulpwood when top diameter utilization is changed from 4-inch to 3-inch top d.i.b. 1/

D.B.H.	Number of 8-foot bolts to 4-inch top				
	2	3	4	5	6
Inches	Percent additional volume to 3-inch top				
6	23	16	12		
7	17	12	10	8	
8		10	8	6	5
9		8	6	5	4
10			5	4	3
11			4	3	3
12			4	3	2

1/ Not to be used on trees where merchantability to 4-inch top is limited by defect or deformity.

April 1947

S. R. Gevorkiantz, Silviculturist

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No. 275

Measuring Forest Nursery Stock

To permit comparisons of forest planting results upon different areas or to check adherence to grading standards, the tree-planter or nurseryman often needs to know the specifications of the planting stock he uses or produces.

The dimensions of the average tree for samples varying from 25 to 200+ trees can be determined simply, rapidly, and accurately by measuring only 5 trees as follows: Arrange the trees upon a flat surface (preferably marked in 1-inch squares) in order of apparent size, grading from the largest on one end to the smallest on the other. Select the middle 5 trees (trees 48, 49, 50, 51 and 52 in a 100-tree sample). The average dimensions of these 5 trees will approximate the average of the entire sample very closely as shown in the table below, based on samples systematically selected from experimental plantings made on the Lower Michigan National Forest.

Average Dimensions of Total Samples and Middle Five Trees

	Unit	2-0 red pine		1-0 red pine		2-1 Scotch pine	
		5-middle trees	25-tree sample	5-middle trees	62-tree sample	5 middle trees	107-tree sample
Stem diameter at ground line	Inches	0.153	0.150	....	....	....	.....
Top length to tip of needles	Inches	4.90	4.81	2.60	2.72	4.84	4.67
Top length to tip of bud	Inches	3.60	3.40	1.60	1.67	3.54	3.25
Root length	Inches	10.70	10.64	6.54	6.59	12.02	12.01
Top weight - green	Grams	2.96	2.94	0.33	0.31	2.38	2.58
Root weight - green	Grams	0.77	0.85	0.10	0.09	1.04	1.06
Top weight - oven-dry	Grams	0.90	0.89	0.18	0.19	1.12	1.18
Root weight - oven-dry	Grams	0.24	0.27	0.04	0.04	0.58	0.58

These average values are applicable only to the extent that the sample is representative of the stock used.

April 1947 Paul O. Rudolf, Silviculturist

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No. 276

Planting Poorly-Drained Wet Sites

In a search for methods to reforest poorly-drained wet sites an experiment was begun in the spring of 1939 on the Medford District of the Chequamegon National Forest, Wisconsin. It involved three methods of ground preparation and several species of trees. The poorly-drained soil is a Spencer silt loam with a stiff silty clay subsoil. Previous plantings of white spruce had failed, apparently because of drowning out, frost heaving, late spring freezing, and poor soil aeration.

The test involved 80 subplots each containing 200 trees or seed spots in an area furrowed in August 1938 with a Killefer plow. Each subplot had 5 furrows, spaced 12 feet apart, with a row of scalps between each pair of furrows. On 40 of the subplots, planting was done on top of the plow lay. The results of the planting after 8 growing seasons are given below.

Age class and species	Survival fall 1946			Average height fall 1946		
	Top of plow lay	Bottom of furrow	Scalp	Top of plow lay	Bottom of furrow	Scalp
	Percent	Percent	Percent	Feet	Feet	Feet
2-2 White spruce	79	50	47	3.7	1.7	2.3
3-2 Norway spruce 1/	62	29	33	1.7	1.4	1.6
2-0 White ash	57	30	20	4.8	2.4	3.5
2-0 Black spruce 2/	54	43	43	4.3	2.4	2.5
2-2 White pine 3/	48	20	27	1.6	1.4	1.4

1/ New growth suffered repeated freezing back in spring.
2/ Trees too small but no 2-1 stock available. Species shows great promise.
3/ Heavy and repeated damage by deer and snowshoe hares.

The results indicate considerably better survival and growth in planting done on the plow lay. The better success of the plow lay planting is attributed to the following factors: (1) better aeration; (2) better drainage; (3) less burial by soil washing; (4) higher fertility due to planting on a double layer of organic matter; (5) less frost heaving; (6) less smothering by dead bracken fern and other undergrowth which often mats down trees planted in furrows; (7) less trampling by deer walking down the furrows.

Based on growth, survival and vigor, black spruce or white spruce seem to show best adaptation to the site with white ash a third possibility. Tamarack might have been highly successful had stock been available.

Planting on the plow lay may have wide application in large scale planting. The furrowing should be done in the dry season the year before planting, with a plow more effective than the Killefer in cutting the furrow slice so that it will lie flat and avoid air spaces.

July 1947 Joseph H. Stoeckeler, Forester

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UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 277

Skidding Damage by Tractors and Horses in Selective Logging of Northern Hardwoods

That tractors cause but little more skidding damage than horses in selective logging of northern hardwoods was indicated by a study recently completed at the Upper Peninsula Experimental Forest in northern Michigan. The areas studied were summer logging jobs in which about 25 percent of the gross volume was removed in 8-foot lengths. The table below compares damage caused by D-2 tractors and teams.

Kind of damage	Number of trees damaged per acre by size classes 1/							
	2-4" d.b.h.		5-9" d.b.h.		10" d.b.h.-up		Total	
	Tractor	Horses	Tractor	Horses	Tractor	Horses	Tractor	Horses
	Number							
Cut 2/	4.0	4.0	...	.2	...	...	4.0	4.2
Uprooted and broken 3/	1.5	.2	.2	...	...	.1	1.7	.3
Large scars 4/	3.5	1.7	.4	...	...	...	3.9	1.7
Small scars 4/	.7	.7	1.6	1.1	1.1	2.2	3.4	4.0
Total	9.7	6.6	2.2	1.3	1.1	2.3	13.0	10.2

1/ Based on 12 acres horse logged and 8 acres tractor logged.
2/ Includes trees cut for skid trails and skidways.
3/ Mostly complete in trees below 5 inches d.b.h. and partial in trees above.
4/ On trunks and roots.

Tractor skidding injured more small trees than horse skidding, but there was no great difference in the larger diameter classes. These data, although not conclusive, show that, if carefully done, tractor skidding need be no more injurious than horse skidding and appears to be no detriment to successful selective logging.

On the credit side, tractor skidding scarified more ground than did horse skidding. This is important in reproducing species such as the valuable yellow birch, which need mineral soil to establish themselves readily.

July 1947

L. G. Engle, Forester

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 278

Response of Young Aspen Suckers to Overhead Shade

Aspen reproduces largely from root-suckers which require full sunlight to develop properly. In forest management, successful regeneration of aspen can be accomplished, therefore, only through clear cutting at the end of the rotation.

The present condition of a stand of 11-year-old aspen sprouts, resulting from cutting, demonstrates the importance of competition upon the development of young aspen.

The original stand was cut to various diameter limits in the late fall of 1935, at the age of 43 years. Each cutting block was two acres in size. The remaining stand was cut in the late fall of 1941. The resulting amount of suckering and subsequent development of the new stand to 1946 is shown in the following table:

Treatments		Stems per acre			Average height in 1946	
		Origin		1946		
1935	1941	1935	1941	Dominants	Total	Dominants
		Number	Number	Number	Feet	Feet
Clear cut	- - -	6,830	.....	1,235	22.0	25.8
8" d.b.h. limit	Clear cut	4,500	300	665	19.4	24.2
9" d.b.h. limit	Clear cut	2,115	815	565	17.4	22.6
10" d.b.h. limit	Clear cut	1,980	1,180	465	13.8	17.0
No cutting	Clear cut	.....	5,800	930	9.5	13.0

Owing primarily to the larger number of trees cut in the lower diameter-limit plots, these became most heavily stocked. The height growth, too, is in direct relation to the degree of cutting. Only the dominants are of interest for future management. Except for the last plot, which had not formerly been cut, the suckers originating from the second cutting will be shaded out by those originating from the first cut.

For aspen regeneration clear cutting -- the elimination of all trees regardless of merchantability -- seems desirable.

July 1947

Paul J. Zehngraff, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM No. 279 ST. PAUL 1, MINNESOTA

Thinning in Cedar Swamps

In the eastern half of the Upper Peninsula of Michigan there are about a quarter million acres of young northern white-cedar, much of it growing on relatively well-drained peat. Due to the present demand for cedar products even as small as 2 inches in diameter, some of these sapling and small pole stands are being clear cut. Although this practice may be sound economics, it is questionable silviculture, for little is yet known about the reproductive capacity of young cedar. Until such information is available, it would seem better forestry to supply the smaller material from thinnings in stands of this kind, at the same time accelerating their growth. The silvicultural possibilities of cedar thinnings on the better sites have been brought out by experiments established by the C.C.C. on the Marquette National Forest.

In December 1935 a thinning was made in an overstocked cedar stand, 1 to 7 inches in diameter and 45 years old, which had come in after logging and fire. The stand was thinned from below, removing 590 poles 2 to 3 inches in diameter per acre, as well as many trees which could now be sold for fencing. Under present market conditions, operations such as this could likely be carried on at no cost or even at a small profit.

A re-examination of the experiment was made by the Station in July 1944. What happened from thinning is shown in the following table:

Treatment	Stand December 1935 after thinning		Stand July 1944 - 8 seasons after thinning	
	Trees	Basal area	Trees	Basal area
	Number	Sq.ft.	Number	Sq.ft.
Thinned (4x5 ft. spacing)	2,140	69	2,030	154
None	7,540	161	3,500	172

Although more than half of the basal area was removed on the thinned plot, this is now almost up to that on the check plot. Of even greater significance is the data on crop trees -- dominants of high quality and excellent vigor. On the check plot there are only 220 such trees per acre with a total basal area of 23 square feet, but on the thinned plot there are 940 such trees per acre with a basal area of 93 square feet. Since there are considerably more cedars and other valuable conifers of merchantable size, 5 to 8 inches in diameter, on the thinned plot than on the untreated plot -- 320 compared to 80 -- a second thinning can be made here in the near future.

Thinnings in cedar probably should be confined to the better drained swamps. A 60-year-old stand a few miles away thinned to the same spacing in 1936 shows no such beneficial response to thinning. Here the water table was practically at the surface of the peat.

July 1947

Eugene I. Roe, Silviculturist

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 280

Forest Fires in the Lake States in 1946

1946 was worse than average for forest fires in the Lake States. Not since 1936 have as many fires been reported in any one year. In spite of this the area burned was held to a quarter of one percent of the area protected.

Starting early in March the fire season lasted until well into November. As usual, the bulk of the fires (about 2/3) occurred in the spring. A dry period in July and August, however, accounted for nearly 25 percent of the total number.

Smoking was the chief cause of the fires (responsible for over a third of the fires reported). Railroad operation and land clearing were major hazards accounting for 22 and 15 percent respectively. A sharp increase in the number of railroad fires was particularly noticeable. Less than one percent of the fires was due to lightning. Altogether, about 27 percent of the fires were deliberately set for one purpose or another, 28 percent may be classed as accidental, while the balance were due primarily to thoughtlessness.

A summary of fire statistics for state and private forest land for 1946 is given on the back of this sheet.

July 1947 J. A. Mitchell, Silviculturist

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 282

Landownership in Sixteen Northeastern Minnesota Counties

For land-use studies and other purposes, it is desirable to know who owns the land. The Lake States Station recently tabulated the landownership in 16 counties of northeastern Minnesota - the so-called cutover counties. (See back of sheet.) This information was not previously available from any one source.

Although the best available, some of the data are only approximately accurate. This is true of those for public owners of tax-forfeited lands, as tax-forfeited landownership, forfeiture, and sale records are not kept on a similar basis in all counties. Urban and industrial acreages are a revision of data obtained during the 1930's, which were quite accurate at that time. These were revised in accordance with estimates of changes in type of ownership and use in the last 10 to 15 years, recreational land being included. It is believed that acreage in recreational use has increased substantially in the last decade. Private forest and wild land are the residual, subtracting acreage in all the other ownerships from total land area as reported by the Census.

October 1947

Howard W. Mayne, Forest Economist

TAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Approximate Ownership of Land in Sixteen Counties of Northeastern Minnesota, 1947

County	Total land area 1/	Urban and industrial 2/	Farms 1/	State land 3/	County land 4/	National Forest 5/	Other federal 6/	Private forest and wild land
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
Aitkin.....	1,167,360	23,588	297,311	389,827	316,166	....	7,487	132,981
Becker.....	841,600	11,276	543,914	30,523	83,580	....	25,040	147,267
Beltrami.....	1,610,880	19,900	335,657	591,775	160,000	53,835	327,692	122,021
Carlton.....	550,400	22,383	238,185	64,387	159,000	....	15,420	51,025
Cass.....	1,313,920	29,190	326,821	145,958	272,760	247,838	64,220	227,133
Clearwater.....	643,200	10,090	274,774	50,584	101,200	....	131,881	74,671
Cook.....	897,920	6,405	13,263	136,264	53,720	550,407	40,100	97,761
Crow Wing.....	639,360	27,987	241,144	22,194	156,240	....	1,746	190,049
Hubbard.....	596,480	14,905	220,582	79,714	163,380	....	299	117,600
Itasca.....	1,704,320	47,868	268,227	324,866	401,000	282,878	12,674	366,807
Koochiching.....	2,002,560	18,383	165,574	1,073,429	353,030	1,765	160,456	229,923
Lake.....	1,364,480	12,105	27,559	186,109	160,000	666,986	279	311,442
Lake of the Woods..	837,120	7,218	153,983	485,237	12,000	....	167,461	11,221
Pine.....	903,680	12,093	408,342	47,060	268,000	....	320	167,865
St. Louis.....	4,019,840	198,903	584,199	557,655	1,360,000	750,279	30,328	538,476
Wadena.....	343,040	8,648	273,205	6,795	20,880	....	....	33,512
Total for 16 counties	19,436,160	470,942	4,372,740	4,192,377	4,040,956	2,553,988	985,403	2,819,754

1/ From U. S. Census of Agriculture, 1945.
2/ Revision of 1934 Forest Survey estimates, 1947. Includes urban, industrial, recreational, highway, and railroad land.
3/ From Minnesota Department of Conservation, March 1947.
4/ Obtained in county offices, October and November 1946.
5/ From U. S. Forest Service (as of June 30, 1946).
6/ Largely Indian and public domain land - from Department of Interior, March 1947.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 283

Converting Volumes Between International 1/4-inch Rule and Scribner Rule

In the Lake States, tree volumes of sawlogs usually are determined by the Scribner Rule. However, the International 1/4-inch Rule is coming into wider use. It is now legal in Michigan, and is favored by many foresters because of its greater accuracy and closer approximation to actual mill tally. Factors for converting volumes from one rule into another, therefore, should be increasingly useful. Such factors are given in the table below. To convert volumes from the International 1/4-inch Rule to those of the Scribner Rule, multiply by the factors shown; to convert from Scribner to International 1/4-inch volumes, divide by the factors. For many purposes the average factor for the diameter class can be used. However, the converted values will fit the volume table closer if the individual factors for diameter breast height and number of logs are used.

Conversion Factors Between International 1/4-inch Rule and Scribner Rule

Tree d.b.h.	Number of 16-foot logs per tree							
	½	1	1½	2	2½	3	4	Average
Inches								
10	.82	.77	.75	...	...	...	...	.77
12	.93	.84	.82	.78	...	...	...	.82
14	.95	.89	.87	.83	.87	...	...	.87
16	.92	.89	.88	.88	.90	.91	...	.89
18	.97	.90	.89	.88	.89	.91	.89	.90
20	.98	.92	.90	.89	.91	.91	.90	.91
22	.99	.93	.90	.91	.91	.91	.92	.92
24	1.03	.94	.92	.93	.92	.92	.93	.93
26	1.04	.94	.93	.94	.94	.94	.93	.94
28	1.04	.95	.94	.94	.94	.94	.94	.94
30	1.03	.94	.95	.94	.95	.95	.94	.95
40	.97	.94	.94	.95	.95	.96	.95	.95

Stump height is one foot. The number of 16-foot logs is for average sawlog or utilization to a variable top not smaller than 8 inches inside bark.

October 1947

S. R. Gevorkiantz, Silviculturist

AINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 284

Veneer Log Production in the Lake States Continues at High Level

The production of veneer logs in the Lake States region in 1946 amounted to approximately 97 million feet, log measure, according to a canvass recently completed by the U. S. Forest Service. In addition to this volume of logs, some 17,000 cords of bolts were produced for heading stock. The survey further shows that Michigan was the heaviest producer of veneer logs of the three states, accounting for approximately 67 percent of the total. Wisconsin was second and Minnesota third with 26 percent and 7 percent, respectively.

To supplement local supplies, several manufacturers of high-grade veneers shipped in some 5 million feet of logs from other parts of the United States and Canada. These shipments consisted largely of yellow birch, cottonwood, and basswood.

Log production is shown, by states, on the reverse of this sheet.

October 1947

A. G. Horn, Forest Economist

TAINED BY THE U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Production of Veneer Logs in the Lake States, by states, Calendar Year 1946

Species	Michigan			Wisconsin			Minnesota			Region		
	Total	Commercial veneer	Container veneer	Total	Commercial veneer	Container veneer	Total	Commercial veneer	Container veneer	Total	Commercial veneer	Container veneer
	Thousands of feet log measure (Scribner Dec. C. scale)											
Ash	1,168	1,112	56	751	497	254	60	60	...	1,979	1,669	310
Aspen	273	25	248	299	196	103	2,975	2,844	131	3,547	3,065	482
Basswood	3,208	2,502	706	4,712	3,757	955	1,155	876	279	9,075	7,135	1,940
Beech	4,854	2,179	2,675	82	62	20	...	...	...	4,936	2,241	2,695
Birch	17,796	17,675	121	3,593	3,572	21	2,158	2,057	101	23,547	23,304	243
Cottonwood	137	...	137	...	...	...	187	62	125	324	62	262
Elm	7,256	2,470	4,786	6,994	2,852	4,142	354	263	91	14,604	5,585	9,019
Maple	28,337	22,281	6,056	6,942	5,922	1,020	74	...	74	35,353	28,203	7,150
Oak	932	480	452	1,783	1,724	59	...	...	...	2,715	2,204	511
Other species 1/	667	622	45	269	176	93	52	52	...	988	850	138
All species	64,628	49,346	15,282	25,425	18,758	6,667	7,015	6,214	801	97,068	74,318	22,750

1/ Includes pine, hemlock, hackberry, sycamore, walnut, and cherry.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 285

Log Grade Following Selection Cutting in Northern Hardwoods

What effect if any does the degree to which a mature stand of northern hardwoods is opened in the first cutting have upon future log grade in the residual stand? In an effort to provide a partial answer to this question, a study was made on the Upper Peninsula Experimental Forest in northern Michigan during 1945 and 1946.

Each log in each tree 10 inches d.b.h. and over on some 25 acres of plots was graded as accurately as possible in the standing tree. Data were restricted (1) to selection cuttings in which trees were removed on the basis of maturity and condition, (2) to an uncut check plot, and (3) to a heavy cutting. The original stand was about 10,000 feet B.M. net per acre, with cull at least one-third of gross volume.

Results of the study are summarized briefly in the table below:

Gross volume removed in first cutting	Log grade proportion 15 years after cutting						
	No. 1 1/	No. 2 1/	No. 3 1/	Mine timber 2/	Chemical wood 3/	Total
Percent	Percent	Percent	Percent	Percent	Percent	Percent
0	20	40	27	2	11	100
24	19	55	19	1	6	100
46	27	38	20	6	9	100
62	20	39	32	5	4	100
68	17	48	22	7	6	100
90	4	39	32	17	8	100

1/ Graded to the O.P.A. specifications contained in MPR 348, Amendment No. 8.
2/ In actual practice some Grade No. 3 logs would likely be marketed for this product. In the study only logs unfit for Grade No. 3 but still acceptable at the mines were included.
3/ Any volume within the merchantable portion of the tree to 8-inch top too poor to make the four better grades.

Differences do not appear too marked except in the case of No. 1 logs. Here, in cuttings which removed more than two-thirds of the gross volume, the percentage of volume in this grade dropped sharply. It appears that light to moderately heavy selection cuttings may be made in the northern hardwood type without impairing grade if a careful marking job is done with no attempt to "high grade" the stand. There is some indication that moderate cutting may actually improve the proportion of the higher grades by increasing the relative volume in Grade No. 1, with consequent reduction in Grade No. 3.

October 1947 W. M. Zillgitt, Silviculturist

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 286

October 1947 Drought Conditions Cause High Forest Fire Danger in the Lake States

Weather conditions in the Lake States during October 1947 were highly favorable for forest fires. On several days, burning conditions were very high or extreme, while the number of fires and the area burned were correspondingly large. In Wisconsin, forest areas were closed by State authority in recognition of the emergency.

This hazardous situation was a result of the combination of poorly distributed and subnormal precipitation, low humidity, above normal temperature, and at times strong winds, together with the normal seasonal increase in highly inflammable fuels on wild lands and the heavy use of wild lands by hunters and others.

Although the lack of precipitation is not alone the cause of severe or increasing fire danger, it does make acute conditions possible. The occurrence and duration of drought periods is therefore of importance in fire control. The accompanying four charts show number of days since rains of 0.2 inch or more for weekly intervals. They point out the variation in severity of the October drought in various parts of the Lake States, and show localities where the build-up of acute conditions was most pronounced.

Rains between October 22 and 28 beginning in Minnesota and spreading eastward ended the emergency generally throughout the region.

January 1948 John S. Crosby, Forester

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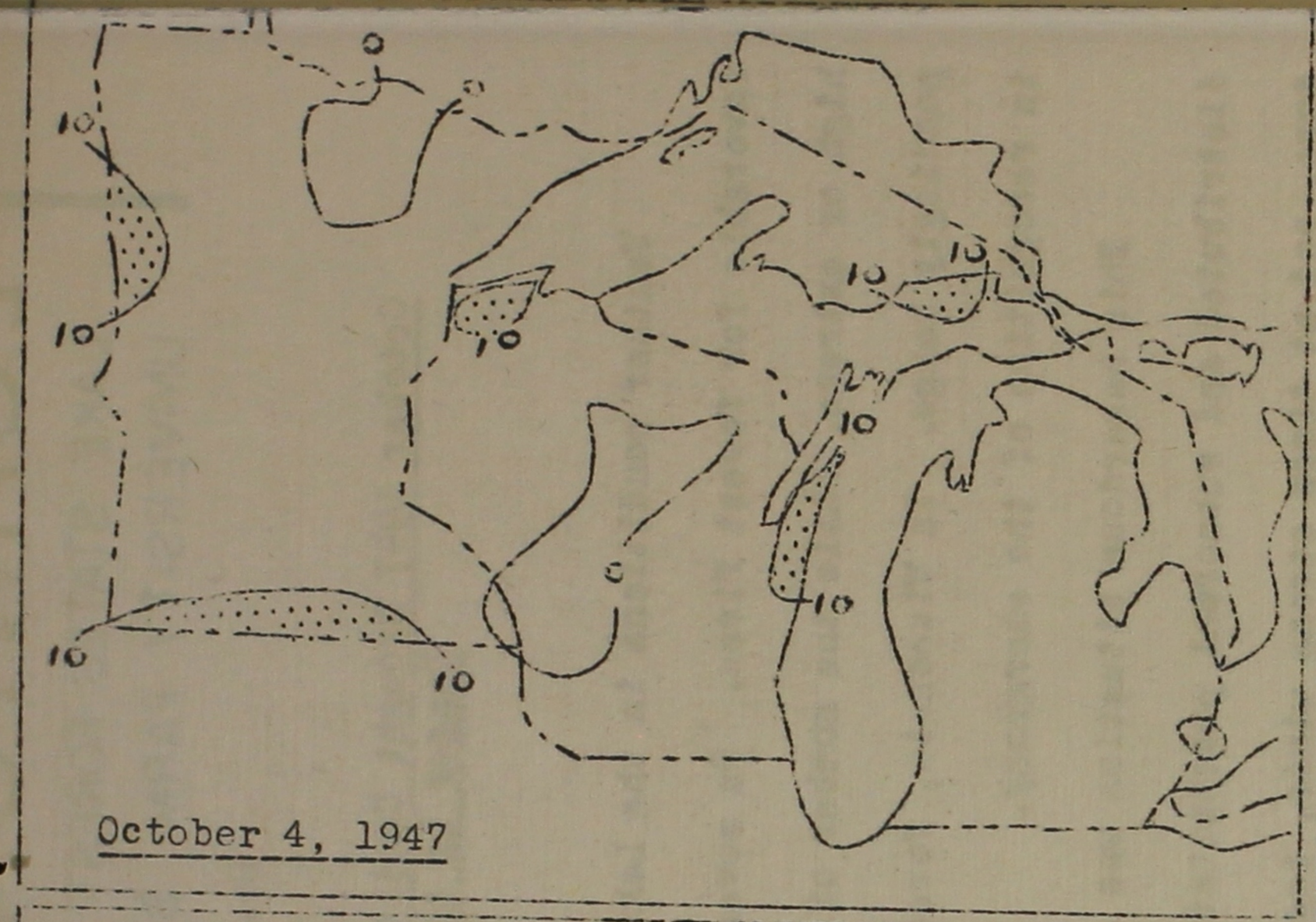
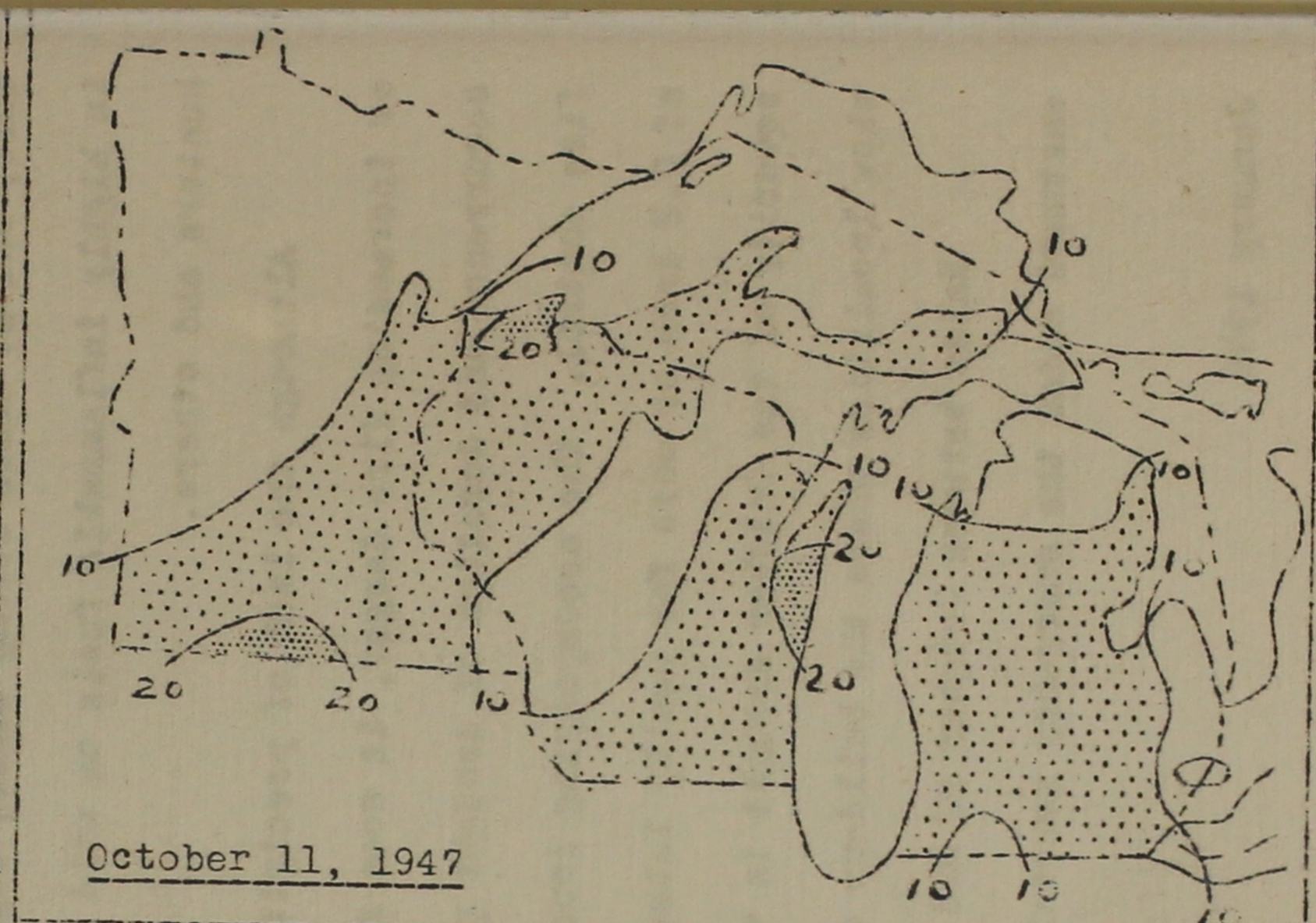
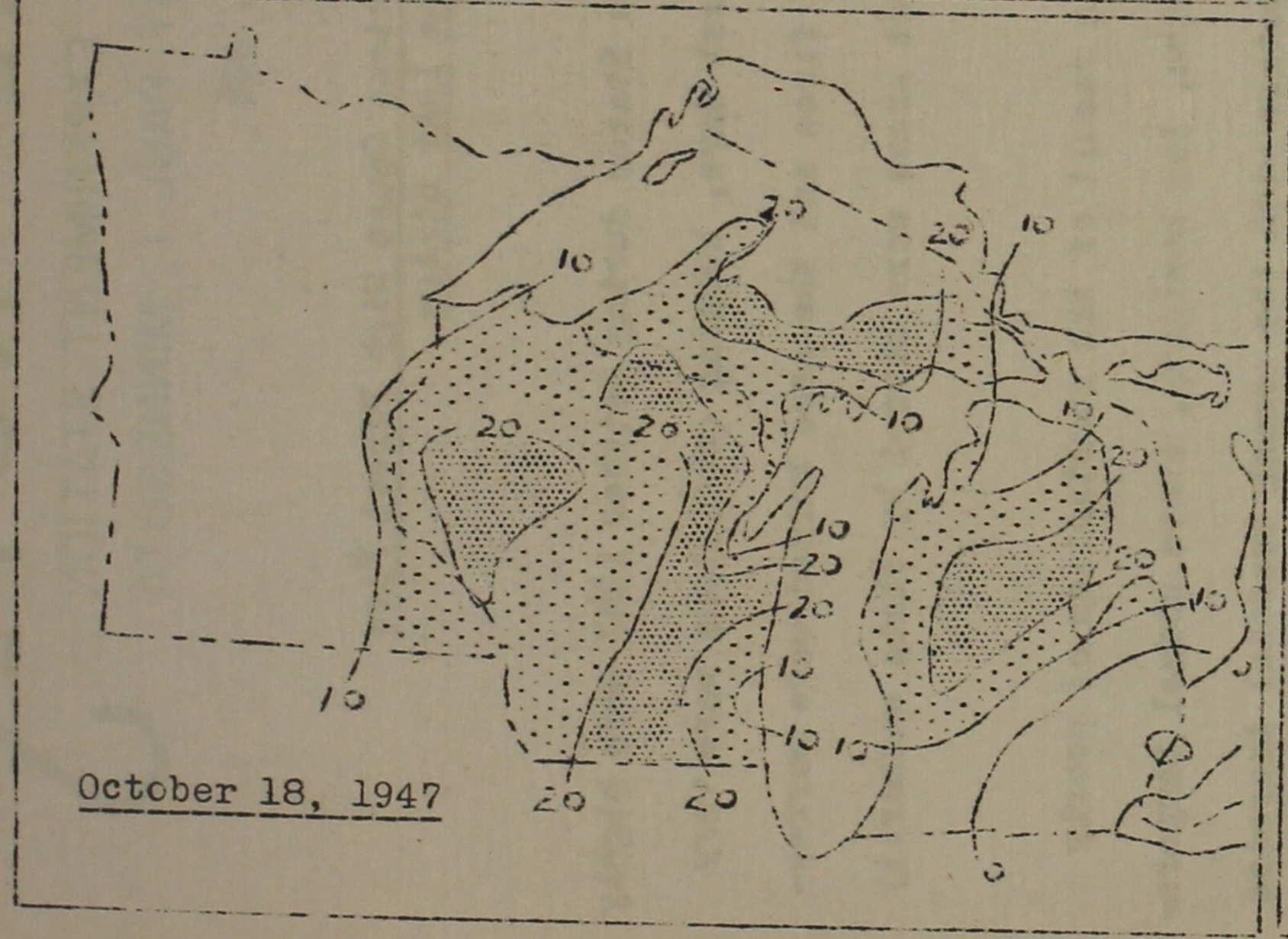
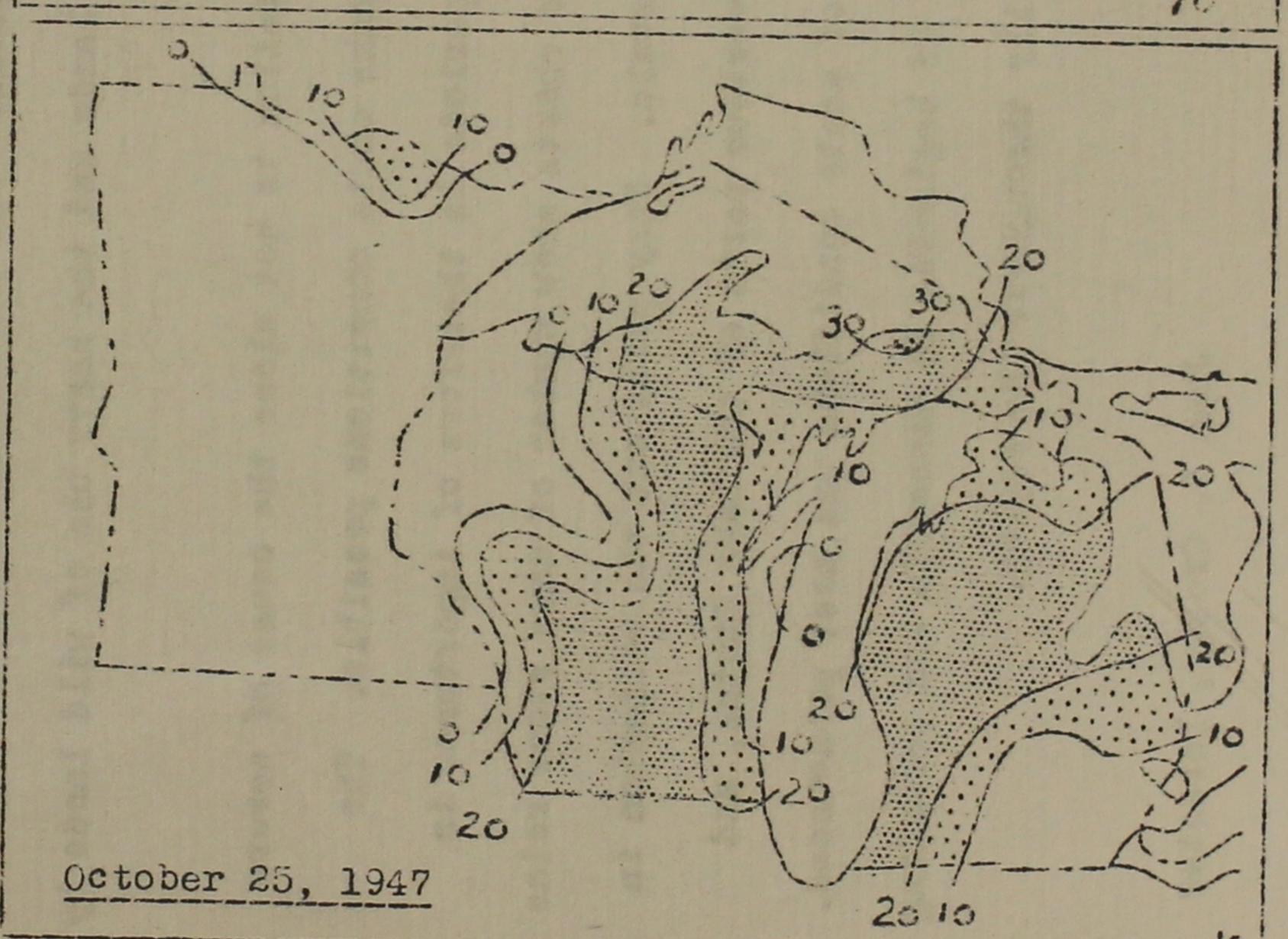








0-10 days | 10-20 days | NUMBER OF DAYS SINCE 0.2 INCH RAINFALL | 20-30 days | Over 30 days

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION

No. 287

U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE

UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Converting Volumes Between International 1/4-inch Rule and the Doyle Rule

That the Doyle rule consistently underscales logs of the size ordinarily harvested in the Lake States is illustrated by the conversion factors given below. Volumes by Doyle rule do not approach closely those given by the International 1/4-inch rule - which approximates mill tally - except in the diameter classes around 40 inches. Most of the timber cut in the Lake States, however, is under 30 inches in diameter. For such timber, the Doyle rule also gives considerably less scale than the commonly used Scribner rule (see Technical Note No. 283).

To convert volumes from the International 1/4-inch rule to the Doyle rule, multiply by the factors given in the table below. To convert from Doyle to International 1/4-inch volumes, divide by the same factors.

Conversion factors between International 1/4-inch rule and Doyle rule for 16-foot logs

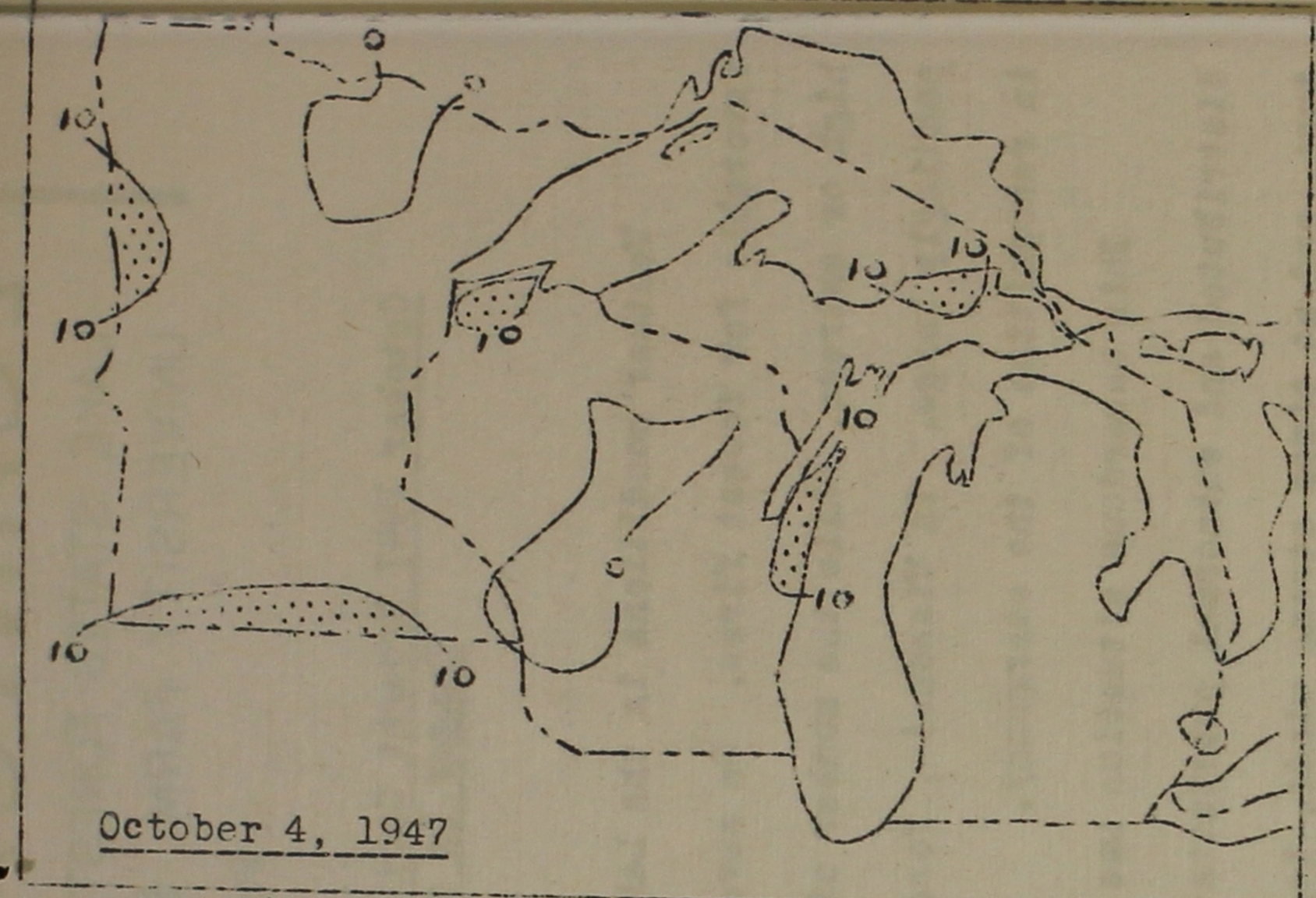
Tree d.b.h.	Doyle volume in percent of volume by International 1/4-inch rule
Inches	Percent
10	39
12	49
14	57
16	64
18	70
20	75
22	79
24	82
26	85
28	88
30	91
32	93
34	95
36	96
38	98
40	99

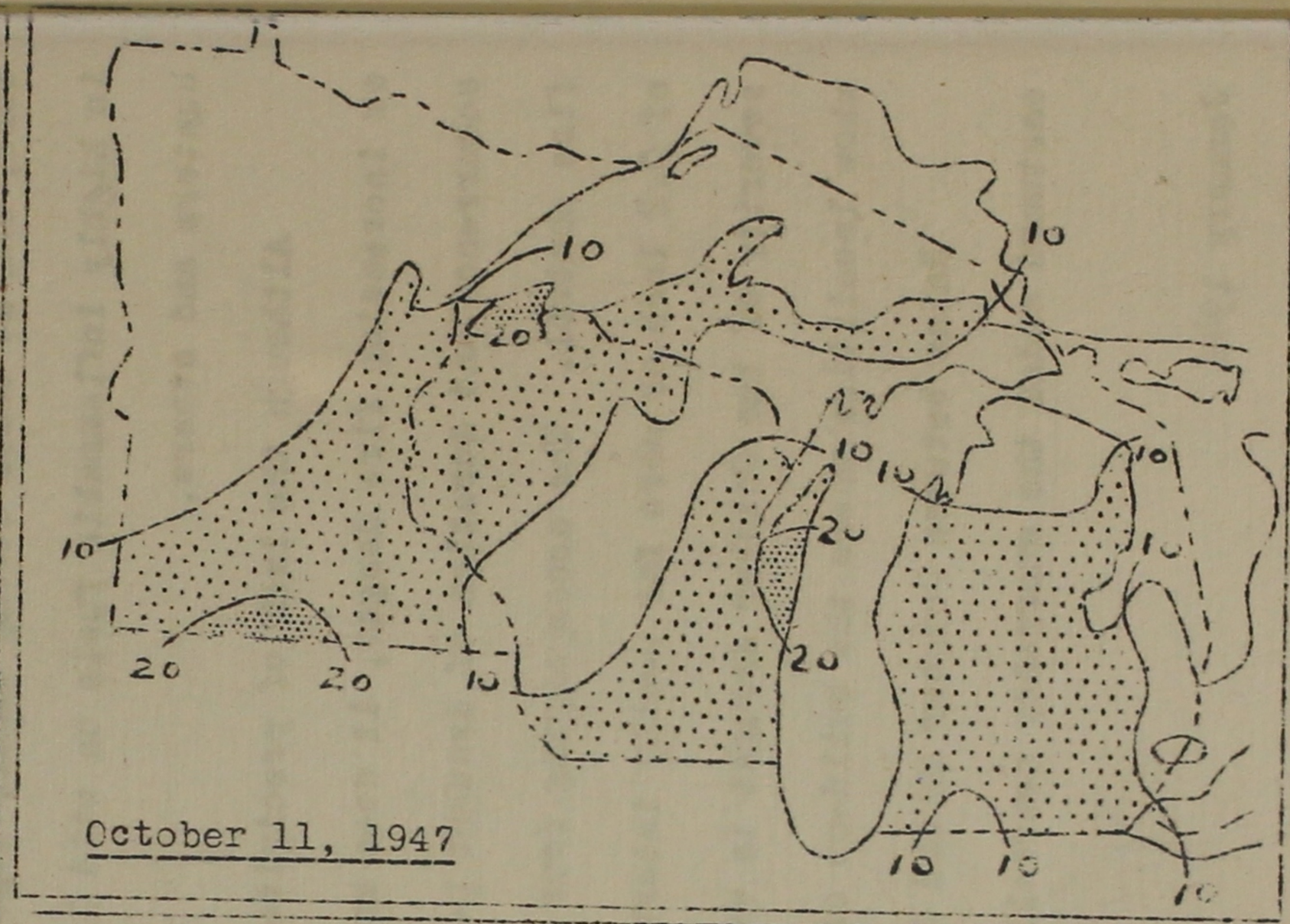
Stump height is 1 foot.

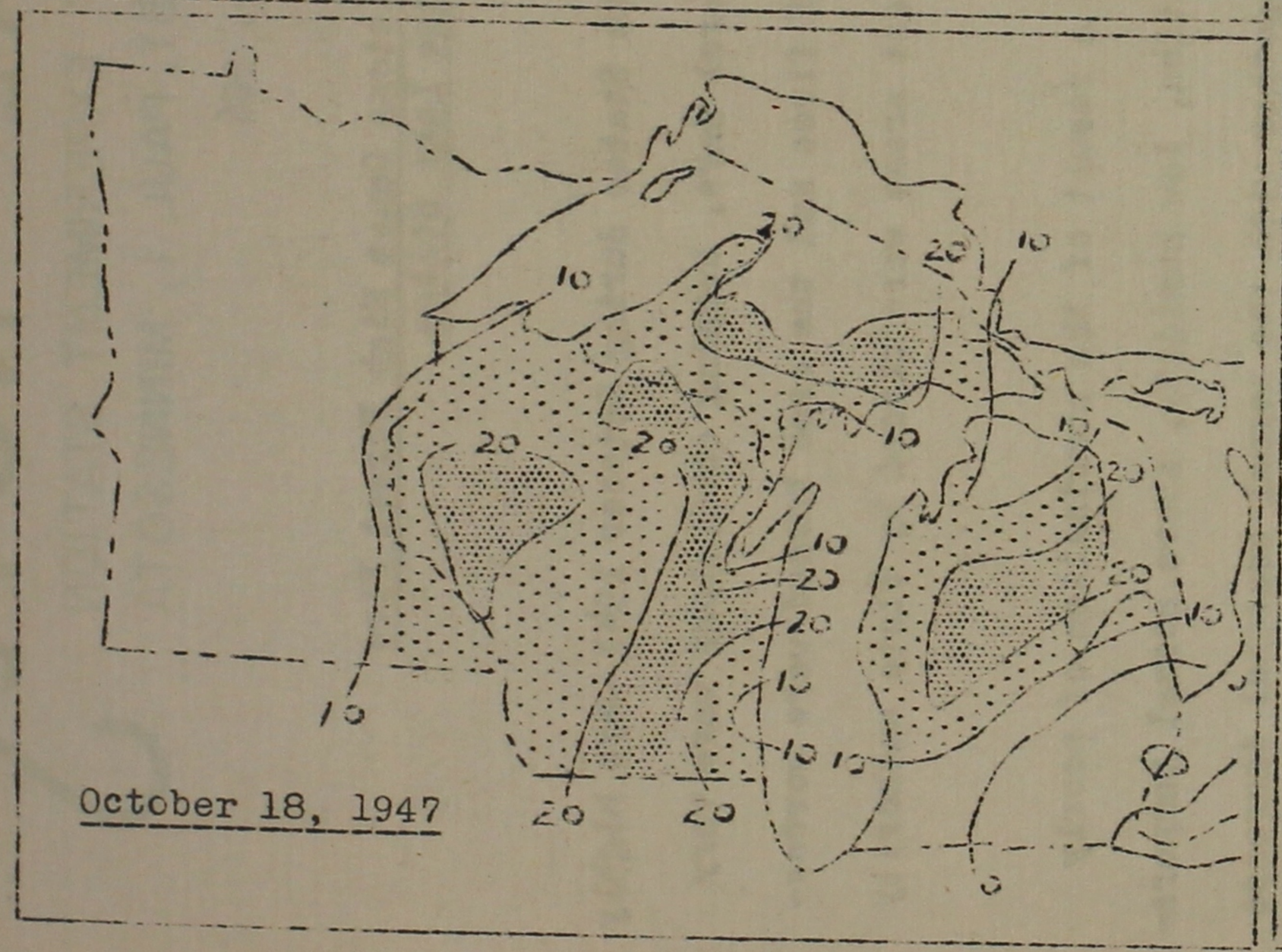
MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

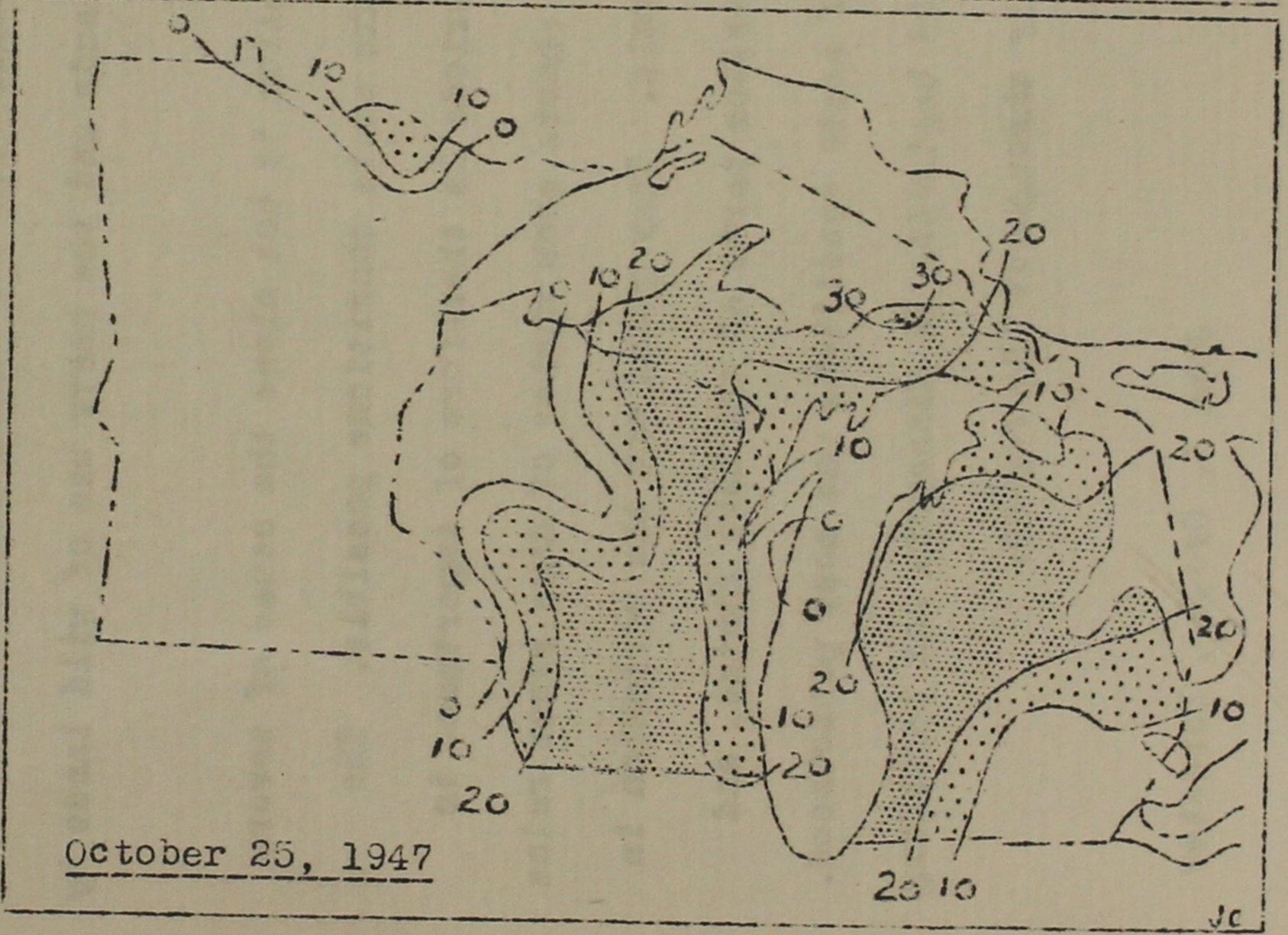
S. R. Gevorkiantz, Silviculturist

January 1948









0-10 days | 10-20 days | NUMBER OF DAYS SINCE 0.2 INCH RAINFALL | 20-30 days | Over 30 days

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION

No. 287

U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE

UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Converting Volumes Between International 1/4-inch Rule and the Doyle Rule

That the Doyle rule consistently underscales logs of the size ordinarily harvested in the Lake States is illustrated by the conversion factors given below. Volumes by Doyle rule do not approach closely those given by the International 1/4-inch rule - which approximates mill tally - except in the diameter classes around 40 inches. Most of the timber cut in the Lake States, however, is under 30 inches in diameter. For such timber, the Doyle rule also gives considerably less scale than the commonly used Scribner rule (see Technical Note No. 283).

To convert volumes from the International 1/4-inch rule to the Doyle rule, multiply by the factors given in the table below. To convert from Doyle to International 1/4-inch volumes, divide by the same factors.

Conversion factors between International 1/4-inch rule and Doyle rule for 16-foot logs

Tree d.b.h.	Doyle volume in percent of volume by International 1/4-inch rule
Inches	Percent
10	39
12	49
14	57
16	64
18	70
20	75
22	79
24	82
26	85
28	88
30	91
32	93
34	95
36	96
38	98
40	99

Stump height is 1 foot.

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

S. R. Gevorkiantz, Silviculturist

January 1948

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 288

Aspen Takes Lead As Pulping Species in Lake States

The importance of aspen to the Lake States pulpwood industry is brought out by a survey recently made by the U. S. Forest Service. In 1946 aspen accounted for about one-third of the total regional pulpwood production of 2¼ million cords, and for the first time on record became the principal pulpwood species of the region. Ten years earlier only about 90 thousand cords of aspen pulpwood were produced in the Lake States.

About three-fourths of the 2.9 million cords of pulpwood received by Lake States mills during 1946 was produced within the region. Of the total regional production, Minnesota supplied about 43 percent, Michigan about 38 percent, and Wisconsin about 19 percent. Pulpwood produced in the Lake States and shipped out of the region amounted to only a little over 50 thousand cords - 7 percent of the quantity imported.

Production and imports of pulpwood, Lake States
calendar year 1946

Species	Production (Standard cords)1/				Imports (Standard cords)1/	
	Minn.	Wis.	Mich.	Region	Other U.S.2/	Canada
Aspen						
Consumed in Minnesota	201,513	-----	-----	201,513	-----	5,588
" " Wisconsin	56,442	202,307	156,773	415,522	-----	-----
" " Michigan	-----	-----	55,439	55,439	-----	13,394
Exported to other states	7,176	-----	34,280	41,456	-----	-----
Total	265,131	202,307	246,492	713,930	-----	18,982
Balsam-fir						
Consumed in Minnesota	61,496	-----	-----	61,496	-----	133
" " Wisconsin	30,673	47,453	86,721	164,847	1,572	114,059
" " Michigan	-----	-----	30,209	30,209	-----	7,187
Exported to other states	1,028	-----	-----	1,028	-----	-----
Total	93,197	47,453	116,930	257,580	1,572	121,379
Birch						
Consumed in Minnesota	-----	-----	-----	-----	-----	-----
" " Wisconsin	1,244	4,306	8,451	14,001	-----	-----
" " Michigan	-----	-----	336	336	-----	-----
Total	1,244	4,306	8,787	14,337	-----	-----
Hemlock						
Consumed in Minnesota	-----	-----	-----	-----	-----	-----
" " Wisconsin	-----	64,127	168,744	232,871	254	-----
" " Michigan	-----	-----	80,866	80,866	-----	-----
Total	-----	64,127	249,610	313,737	254	-----

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Species	Production (Standard cords)1/				Imports (Standard cords)1/	
	Minn.	Wis.	Mich.	Region	Other U.S.2/	Canada
Pine						
Consumed in Minnesota	155,388	-----	-----	155,388	-----	19,513
" " Wisconsin	165,317	75,353	42,788	283,458	8,777	5,966
" " Michigan	12,040	-----	41,759	53,799	-----	31,494
Total	332,745	75,353	84,547	492,645	8,777	56,973
Spruce						
Consumed in Minnesota	136,262	-----	-----	136,262	-----	4,881
" " Wisconsin	112,317	31,784	87,208	231,309	16,056	397,285
" " Michigan	-----	-----	39,689	39,689	-----	93,114
Exported to other states	9,066	-----	-----	9,066	-----	-----
Total	257,645	31,784	126,897	416,326	16,056	495,280
Tamarack						
Consumed in Minnesota	6,213	-----	-----	6,213	-----	-----
" " Wisconsin	12,404	2,475	996	15,875	107	-----
" " Michigan	-----	-----	2,214	2,214	-----	-----
Total	18,617	2,475	3,210	24,302	107	-----
Miscellaneous Hardwoods						
Consumed in Minnesota	-----	-----	-----	-----	-----	-----
" " Wisconsin	25	93	-----	118	-----	-----
" " Michigan	-----	-----	8,135	8,135	-----	-----
Total	25	93	8,135	8,253	-----	-----
Waste (Slabs, etc.)						
Consumed in Minnesota	8,320	-----	-----	8,320	-----	-----
" " Wisconsin	-----	200	-----	200	-----	-----
" " Michigan	-----	-----	-----	-----	-----	-----
Total	8,320	200	-----	8,520	-----	-----
All species						
Consumed in Minnesota	569,192	-----	-----	569,192	-----	30,115
" " Wisconsin	378,422	428,098	551,681	1,358,201	26,766	517,310
" " Michigan	12,040	-----	258,647	270,687	-----	145,189
Exported to other states	17,270	-----	34,280	51,550	-----	-----
Total	976,924	428,098	844,608	2,249,630	26,766	692,614

1/ Rough wood basis (4x4x8 feet).
2/ Montana, Idaho, and South Dakota.

January 1948

A. G. Horn, Forest Economist

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 289

Small Sawmills Cut Much Lumber in Southern Minnesota

Approximately 770 sawmills operated in the 62 southern counties of Minnesota during 1943, 1944, and 1945. These mills cut 31,631 M, 43,457 M, and 31,794 M board feet of lumber in the three years respectively. No one mill produced as much as 1 million feet in one year.

The distribution of the mills and the quantity of lumber sawed by counties is of considerable interest to many conservationists and agricultural leaders. A tabulation by counties is presented in the following table:

County	Total number mills 1/			Lumber production		
	1943 2/	1944 2/	1945 3/	1943 2/	1944 2/	1945 4/
	Number	Number	Number	M bd.ft.	M bd.ft.	M bd.ft.
Anoka	8	8	9	112	182	126
Benton	9	9	8	1,129	1,795	1,032
Big Stone	0	0	0	0	0	0
Blue Earth	27	28	24	820	1,090	780
Brown	17	17	18	754	860	877
Carver	17	17	17	777	875	762
Chippewa	3	3	3	5/ 51	5/ 32	6/ 53
Chisago	11	11	9	1,485	1,463	1,471
Cottonwood	0	0	0	0	0	0
Dakota	5	5	4	25	50	7/ 165
Dodge	10	11	11	162	278	91
Douglas	16	16	16	371	352	293
Faribault	11	11	13	434	407	461
Fillmore	42	41	41	1,453	1,721	1,201
Freeborn	10	10	12	414	388	478
Goodhue	20	21	20	1,622	1,718	1,577
Grant	0	0	0	0	0	0
Hennepin	11	11	12	330	503	416
Houston	32	34	35	2,575	3,041	1,686
Isanti	16	17	14	922	1,639	1,295
Jackson	5	5	5	8/ 717	8/ 605	8/ 280
Kanabec	12	12	13	594	944	595
Kandiyohi	15	16	16	88	137	123
LeSueur	27	26	25	1,020	986	756
Lac qui Parle	3	3	2	30	30	(6/)
Lincoln	0	0	0	0	0	0
Lyon	1	1	1	0	0	0
McLeod	9	9	9	686	694	673
Martin	2	2	2	(8/)	(8/)	(8/)
Meeker	12	12	11	301	522	213
Mille Lacs	17	18	19	1,191	1,812	1,018
Morrison	40	39	41	1,942	3,418	2,722

County	Total number mills 1/			Lumber production		
	1943 2/	1944 2/	1945 3/	1943 2/	1944 2/	1945 4/
	Number	Number	Number	M bd.ft.	M bd.ft.	M bd.ft.
Mower	8	8	8	126	162	161
Murray	1	1	1	0	0	0
Nicollet	20	20	19	719	854	669
Nobles	1	1	1	0	0	0
Olmsted	18	19	19	951	1,736	931
Ottertail	54	56	57	1,320	4,219	9/1,599
Pipestone	0	0	0	0	0	0
Pope	12	12	12	84	109	91
Ramsey	0	0	0	0	0	0
Redwood	5	5	4	21	23	10/ 61
Renville	11	11	12	330	285	366
Rice	15	15	16	390	430	888
Rock	0	0	0	0	0	0
Scott	20	20	19	498	800	704
Sherburne	7	8	7	49	124	123
Sibley	20	20	19	676	1,073	812
Stearns	30	29	30	2,087	2,254	1,631
Steele	15	15	14	258	224	338
Stevens	3	3	3	0	1	0
Swift	1	1	1	(5/)	(5/)	(6/)
Todd	21	21	19	540	968	688
Traverse	0	0	0	0	0	0
Wabasha	16	16	15	1,146	1,414	1,021
Waseca	8	8	10	266	322	470
Washington	9	9	8	156	155	(7/)
Watonwan	1	1	1	(8/)	(8/)	(8/)
Wilkins	0	0	0	0	0	0
Winona	32	32	29	761	783	436
Wright	27	28	29	1,210	1,964	1,661
Yellow Medicine	3	3	3	38	15	(10/)
Total	766	775	766	31,631	43,457	31,794

Where less than three active mills were found in a county, production is combined to avoid disclosing records for individual operations.

1/ Total all mills (including idle mills).
2/ 1943 and 1944 data collected by Timber Production War Project.
3/ Bureau of Census record for active mills with known idle mills added.
4/ Bureau of the Census report.
5/ Chippewa and Swift counties - combined production.
6/ Chippewa, Lac qui Parle, and Swift counties - combined production.
7/ Dakota and Washington counties - combined production.
8/ Jackson, Martin, and Watonwan counties - combined production.
9/ Clay and Ottertail counties - combined production.
10/ Redwood and Yellow Medicine counties - combined production.

January 1948

J. R. Neetzel, Forester

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 290

Killing Nursery Weeds with Oil Sprays

Oil sprays applied several times during the growing season give promise of reducing weeding costs in coniferous forest nurseries as much as 70 to 80 percent. That is implied by a test made in the summer of 1947 at the Hugo Sauer Nursery, Rhinelander, Wisconsin, on red pine and white spruce seedling and transplant beds.

Tried were No. 1 burner oil, Stoddard solvent, Sovasol No. 5, Weedone, and Esteron 44. The first is an ordinary oil normally burned in furnaces and stoves; Stoddard solvent and Sovasol No. 5 are used by dry cleaners; Weedone and Esteron 44 are 2,4-D products.

Of the five products tested, Stoddard solvent and Sovasol No. 5 gave best weed control, with little or no injury to the coniferous trees. These materials cost about 20 cents per gallon if purchased in bulk. The No. 1 burner oil was not very effective, while the 2,4-D products caused injury to the trees, hence are not considered safe for direct application to the seed beds.

The reduction in weeds in beds of first-year red pine at the end of two weeks (sprays applied July 17) is shown in the table below:

Treatment	Weeds killed (Percent)
Stoddard solvent	91.2
Sovasol No. 5	90.8

The sprays were applied full strength as a fine mist with a high pressure garden sprayer, using as little as 70 to 80 gallons per acre. Treatment was most effective on weeds less than 3 inches in height or spread. These began to turn brown within two or three hours after treatment, and were dead a few days later. Larger weeds and quack grass were generally not killed by the oil sprays. Treatments as heavy as 215 gallons per acre were tried, but these caused a slight burning of the foliage, particularly near the base of the needles of second-year red pine. Apparently amounts over 120 gallons per acre may be injurious to the conifers. There seems to be less chance of oil injury to the evergreens if spraying is done on reasonably cool days. The sprays should not be used on beds of hardwood trees because they may be severely injured or killed.

Reports are that the oils most effective in weed control invariably have about 15 percent by volume of aromatic hydrocarbon. Oil sprays have been used successfully on other crops, notably in controlling weeds in fields of carrots and parsnips and in nurseries growing guayule, a rubber-bearing plant native to the deserts of northern Mexico. No ill effects to the soil have been observed even after use for a number of years. Apparently the oils are quite volatile and evaporate shortly after application.

January 1948

Joseph H. Stoeckeler, Forester

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 291

Time Required to Cut Black Spruce Trees

The introduction of mechanized equipment into the felling and bucking operations of pulpwood logging often calls for a time comparison of power-tool cutting with hand methods to determine which is more economical. For this purpose it is necessary to know how much time is needed in hand-cutting trees of various sizes. Such information was obtained by time and motion studies made in connection with a black spruce pulpwood utilization project carried out near Big Falls, Minnesota, by the Minnesota Division of Forestry, the Minnesota and Ontario Paper Company, and the Lake States Forest Experiment Station.

The cutting operation consisted of felling the tree, bucking it up into 8-foot sticks at the point of felling, lopping the slash to lie close to the ground, cutting skid-trail, and piling the wood in small piles along the skid-trail. Cutters worked singly.

By applying the figures from the following table to a stand table for the area to be cut, an estimate can be made of the time required for the hand-cutting operation.

April 1948

Zigmond A. Zasada, Forest Economist

AINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Time Required in Cutting Black Spruce Trees of Various Diameters to Three Top Utilization Standards

Activity	Top Utilization	Breast high diameter of trees						
		4"	5"	6"	7"	8"	9"	10"
	Inches	Time in seconds						
Felling	2½	54	75	100	128	160	192	246
	3	54	75	100	128	160	192	246
	4	54	75	100	128	160	192	246
Bucking	2½	76	112	155	205	260	320	385
	3	62	96	140	190	240	300	355
	4	44	80	120	170	220	270	325
Limbing	2½	24	50	85	135	185	230	270
	3	14	40	75	125	170	210	240
	4	-	14	45	85	125	160	185
Lopping	2½	25	30	35	38	35	35	30
	3	39	40	42	42	40	40	35
	4	58	65	68	70	68	64	60
Piling	2½	39	62	88	115	144	174	204
	3	32	56	82	110	138	166	196
	4	20	42	70	95	124	152	184
Miscellaneous	2½	84	84	84	84	84	84	84
	3	84	84	84	84	84	84	84
	4	84	84	84	84	84	84	84
Total	2½	302	413	547	705	868	1,035	1,219
	3	285	391	523	679	832	992	1,156
	4	260	360	487	632	781	922	1,084
		Basis - Number of Trees						
	2½	34	83	112	82	50	22	3
	3	55	85	99	96	48	12	1
	4	8	74	105	116	59	21	11

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 292

Sawmill Air Dogs Save Time

Air dogs (mechanical devices for holding a log on the sawmill carriage), practical for most circular sawmills and small band mills, were developed in 1946 in cooperation with the Michigan Agricultural Experiment Station. They are simple in design, adaptable to a wide variety of headblocks, and low in cost. In contrast, the air dogs previously on the market were expensive and designed for high-production sawmills, principally of the band-headrig type.

The use of these air dogs effected a time saving of 6½ percent over the sawing operation using hand dogs, according to a recent time study at the L. L. Johnson Lumber Company sawmill in Charlotte, Michigan. For 498 logs there were recorded the time required for (1) undogging, (2) turning and taper setting, (3) dogging, (4) reaching the setting position, (5) setting, (6) feeding to cut, and (7) the sawing operation as a whole. The study showed that air dogs saved time in operations (1), (3), (4), and (6).

In the standard 8-hour operating day 37½ minutes were consumed by saw changing, minor repairs, and other nonproductive operations, leaving 442½ minutes of actual operating time. The use of the air dogs resulted in the saving of 28½ minutes or nearly one-half hour per day. The value to the mill of each operating minute is about 50 cents, so the saving amounts to $14.25 less 75 cents per day for depreciation and operating expenses, or $13.50 per day. The owners of the mill feel that of additional value is the greater efficiency of the block setter through (1) reduction of fatigue, (2) safer working conditions, and (3) his increased working life.

April 1948

J. W. Creighton, Agent

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 293

Shelterbelts as "Conservers" of Moisture

Trees, themselves, do not conserve moisture. In fact, measurements in the Plains show that they draw upon soil moisture more fully and to a greater depth than annual crops grown near them.

A comprehensive study of soil moisture that showed a deficiency of 3.25 inches of water under the trees (sampling included all moisture from surface to 8 feet) brought out also that from about 1 H (H is one belt height) to 4 H north of the shelterbelts, there was, after the harvesting of the field crops in 1935, an excess of residual moisture; north from this point the moisture level was essentially constant, except for a depression at 7 H which is apparently associated with a down-draft of air noted here with certain windbreak types. The excess moisture at 2 H and 3 H north averaged 1.6 inches of water.

It is possible that water from snowdrifts very near the shelterbelts on the north was not fully utilized in growing the crops; but, also, moisture did not accumulate farther from the belts, as a result of protection from the warm and drying south winds, beyond the range of 4 H. Since wind reductions do not end so abruptly, it appears that a temperature factor is also involved.

Soil evaporation was directly measured in 1936-38 in this manner: Pots of soil of uniform texture and moisture were placed at various distances north and south of east-west windbreaks, and exposed for periods of 3 to 6 months to differences in wind movement produced by the windbreaks. These were summer tests, with wind predominantly south in Kansas, but nearly balanced between north and south in North Dakota. The three series run in Kansas and the seven in North Dakota (all on same field) were combined. Values for each station were computed in each test as percentages of the average for all stations. Actual total amounts of evaporation per test varied from 5.8 to 9.1 inches. The table on the reverse side shows averages of the 10 percentages as well as measures of variability.

This test indicates that reduced wind movement to the north of a windbreak, plus the cooling effect on an area deprived of sun heat, reduced evaporation at 1 to 5 H; while lesser wind reduction to the south, plus reflected heat, produced increased evaporation at corresponding stations. The average evaporation from 10 H south to 10 H north was about 1 percent less than at 15 and 20 H on both sides, and this difference may represent the effect of wind reduction alone.

April 1948

C. G. Bates, Silviculturist

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Average Evaporation From Pots of Soil in North Dakota and Kansas
1936-1938

(Includes all moisture from surface to 8 feet)

Direction and distance from windbreak in "height" units	Average evaporation in percentage 1/	Sum of departures squared	Standard deviation
S. 20	101.86	264.8671	2/ 5.42
S. 10	98.77	203.2898	2/ 4.75
S. 7.5	98.75	116.3925	2/ 3.60
S. 5	101.04	206.9488	4.80
S. 3	100.62	25.1813	1.67
S. 2	101.76	52.1396	2.41
S. 1	103.13	180.0406	4.47
Windbreak	.....	.....	....
N. 1	98.35	62.5086	2.64
N. 2	97.55	40.3510	3/ 2.12
N. 3	98.50	52.7965	2.43
N. 5	98.64	46.3556	2.27
N. 7.5	100.21	137.0426	3.90
N. 10	100.38	54.8110	2.47
N. 20	100.44	147.3132	4/ 4.05

1/ Average evaporation of all measurements is taken as 100 percent. Value for each distance is average of 10 measurements.
2/ Differences in this group not significant. Average of the 3 is 99.29 percent.
3/ Significantly different at the 1 percent level from S1, S2, and S3.
4/ Difference between this point and N2 is significant at about the 6 percent level.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 294

Lake States Operators Increase Cut of Excelsior Wood - 1946

Approximately 95,000 cords of excelsior bolts were harvested from Lake States forests in 1946, according to a canvass by the U. S. Forest Service. This is about 50 percent above the 1936 cut of 63,000 cords. The species most in demand continues to be aspen, as it was 10 years before.

Of the regional total, Michigan supplied 52 percent, Wisconsin 45 percent, and Minnesota 3 percent. In Michigan most of the excelsior wood was cut in the Upper Peninsula; Wisconsin cutting was concentrated largely in the north half of the state; while in Minnesota cutting was limited mostly to northeastern counties. Eighty percent of the regional cut was used in Wisconsin, 20 percent in Michigan, and none in Minnesota.

Reports from operators indicate that excelsior bolts were neither shipped out of nor into the region in 1946.

Quantity of Excelsior Bolts Cut, Lake States
Calendar Year 1946

Species and destination	Amount cut by states			
	Minnesota	Wisconsin	Michigan	Region
	Standard cords (rough wood)			
Aspen				
To Minnesota	.....	.....	.....	.....
Wisconsin	2,988	36,998	30,632	70,618
Michigan	.....	.....	18,922	18,922
Total	2,988	36,998	49,554	89,540
Basswood				
To Minnesota	.....	.....	.....	.....
Wisconsin	308	5,615	.....	5,923
Michigan	.....	.....	.....	.....
Total	308	5,615	.....	5,923
All species				
To Minnesota	.....	.....	.....	.....
Wisconsin	3,296	42,613	30,632	76,541
Michigan	.....	.....	18,922	18,922
Total	3,296	42,613	49,554	95,463

April 1948

A. G. Horn, Forest Economist

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 295

The 1947 Forest Fire Season in the Lake States

The 1947 fire season in the Lake States was slightly worse than average but much less severe than 1946. It was marked, however, by an unusually dry summer and extremely critical conditions in the fall. As a result, a number of large and costly fires occurred.

The spring fire season started late, about the tenth of April, and ended about the middle of May. June, July, and August were increasingly dry, resulting in more than the usual number of summer fires. September was generally wet, which temporarily relieved the situation, but lack of precipitation in October, together with low humidity and high winds, gave rise to acute conditions in central Minnesota, Wisconsin, and Michigan. As a result, the hunting season was temporarily closed in Wisconsin, and smoking and campfires in woodland areas were prohibited in Michigan until general rains late in the month ended the fire season.

Smoking was again the chief cause of forest fires, with railroads a close second. In 1947, these two causes alone were responsible for over 60 percent of the fires reported and for 37 percent of the area burned. The steady increase in the number of railroad fires the past few years has led all three states to urge the railroads to burn over their right-of-way as a means of safeguarding adjoining property.

While, like everything else, the cost of forest fire protection has increased materially the past few years, its effectiveness has also increased. This has been due primarily to the prompt and effective action on fires while still small made possible by modern equipment and more adequate and better trained protection organizations. Compared to 1936, the last year in which similar conditions prevailed, 1947 had 50 percent fewer fires, 75 percent less area burned, and a 60 percent decrease in the size of the average fire. While under normal conditions present protection in Michigan and Wisconsin may be considered adequate, large fires are still a problem and there is no assurance that an exceptionally dry year will not be disastrous.

A summary of forest fire statistics for state and private lands for 1947 appears on the back of this sheet.

April 1948

J. A. Mitchell, Silviculturist

AINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Summary of
STATE FOREST FIRE STATISTICS
Calendar Year - 1947

Item	Michigan	Wisconsin	Minnesota	Totals	10-year avg. 1937-1946
Area protected - acres	15,928,000	15,653,000	18,142,000	49,723,000	48,402,000
Number of fires	1,539	1,398	935	3,872	3,350
Area burned - acres	24,851	16,007	60,014	100,872	89,109
Estimated damage	$ 158,723	$ 74,645	$ 156,306	$ 389,674	$ 231,072
Cost: Fire prevention	$ 1,298,480	$ 691,177	$ 677,450	$ 2,667,107	$ 1,525,506
Fire suppression	$ 111,537	$ 46,607	$ 60,273	$ 218,417	$ 92,924
Total loss plus cost	$ 1,568,740	$ 812,429	$ 894,029	$ 3,275,198	$ 1,849,502
Risk of fires starting - number per 100,000 acres protected	9.7	8.9	5.2	7.8	6.9
Risk of fires spreading - size of average fire (acres)	16.1	11.4	64.2	26.1	26.0
Risk of burning - percent of protected area burned	0.16	0.10	0.33	0.20	0.18
Destructiveness - average loss per acre burned	$ 6.39	$ 4.66	$ 2.60	$ 3.86	$ 2.39
Risk of loss - average loss per acre protected	$ 0.010	$ 0.005	$ 0.009	$ 0.008	$ 0.005
Cost of fire prevention - per acre protected	$ 0.082	$ 0.044	$ 0.037	$ 0.054	$ 0.032
Cost of fire suppression - per fire	$72.47	$33.34	$64.46	$56.41	$27.74
Effectiveness of fire control - percent of fires under 10 acres	86.7	94.0	66.0	84.4	78.1
Loss plus cost - per acre protected	$ 0.098	$ 0.052	$ 0.049	$ 0.066	$ 0.038

Note: For 1946 statistics see Technical Note No. 280.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 296

Local Red Pine Seed Develops Best Plantations

Use red pine seed from the home locality if you want the best plantation. That is the conclusion drawn from a test planting established in the spring of 1931 by the Lake States Forest Experiment Station on the Superior National Forest in northeastern Minnesota.

Red pine stock (1-1) of 37 seed origins (from the Lake States and New England) was planted in furrows on a good loamy soil which had been cleared and stumped. The development after 16 years in the field (18 years from seed) is shown in the table on the back of this sheet. The volume per acre of satisfactory trees combining quantity and quality growth is the criterion of success.

While final answers must await the development of the trees to maturity, the present results give a basis for future seed collection policies. It seems reasonably safe to draw these conclusions from the results after 16 growing seasons, as applied to planting of red pine on the inland portions of the Superior National Forest:

1. For best assurance of success, collect red pine seed from inland northeastern Minnesota localities, avoiding trees with thin foliage.

2. Do not use red pine seed from New England, lower Michigan, central Wisconsin, or northwestern Wisconsin.

3. If northeastern Minnesota red pine seed is unobtainable, second choice should go to north-central Minnesota or northeastern Wisconsin.

July 1948

Paul O. Rudolf, Silviculturist

NTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Development of planted red pine according to seed source, end of 16th year

Region of seed origin	Sources	Average survival	Average height	Average d.b.h.	Basal area per acre	Unpeeled volume 1/ per acre	Trees of good form	Better dominant and co-dominant trees 2/	Premium trees 3/	Unpeeled volume 1/ per acre satisfactory trees 4/
	No.	Pct.	Feet	Inches	Sq.ft.	Cu.ft.	Pct.	Pct.	Pct.	Cu.ft.
Northeastern Minnesota	7	72	13.3	2.8	40	255	92	86	49	253
North-central Minnesota	3	82	13.1	2.7	37	236	87	83	53	224
Northeastern Wisconsin	7	68	13.4	2.8	35	210	89	85	53	206
Upper Peninsula, Michigan	4	70	12.6	2.6	32	181	88	79	45	176
Northwestern Wisconsin	5	73	12.3	2.4	29	165	88	77	49	160
Central Wisconsin	4	64	12.4	2.5	27	154	81	79	45	149
Lower Michigan	5	59	12.2	2.4	24	135	85	77	39	131
New England	2	58	11.2	2.1	18	94	84	69	26	90
All	37	68	12.8	2.6	32	189	87	81	47	184

1/ Approximate volume obtained by formula.

2/ Dominants and codominants competing with trees of equal or poorer development.

3/ Sound dominants of good form and a good crown over 2/3 filled with healthy foliage, competing only with trees of poorer development.

4/ Sound dominants and codominants with good form and crowns over 1/3 filled with healthy foliage, competing with trees of equal or poorer development.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 297

Mortality Losses are Low in Managed Forests

A recent re-inventory of the Cutfoot Experimental Forest in northern Minnesota illustrates an important but little-realized benefit of forest management - that the salvage of prospective mortality by proper marking at the proper time may equal or exceed the net growth on the residual stand. Without management this extra return would be largely lost.

The Cutfoot Experimental Forest of 2,346 acres was cut over in 1940 and 1945, largely to salvage mature jack pine which made up about 40 percent of the growing stock. As a result, 94 percent of the expected saw-timber mortality was salvaged.

The percent of net growth, salvage, and mortality loss, by types, for the 1940-45 period are shown below:

Species	Net growth		Salvage		Mortality loss	
	Cubic feet	Board feet	Cubic feet	Board feet	Cubic feet	Board feet
	Percent of original stand					
Jack pine.....	1.65	2.10	9.24	11.23	1.18	.67
Red pine.....	4.06	5.19	.82	.81	.16	.05
White pine.....	7.52	5.80	.74	.77	.10	.04
Spruce-balsam...	9.17	12.06	.30	.40	1.53	2.17
Cedar-tamarack..	6.91	9.23	....	....	1.04	.98
Hardwoods.....	7.45	9.12	.33	.73	.54	.62
All species.....	3.33	4.15	4.42	4.86	.67	.32

The annual net growth on the residual stand was 550 M board feet, Scribner rule. The prospective annual mortality was 687 M board feet, of which 645 M board feet were salvaged as usable products. The net annual mortality loss consisted of 42 M board feet of unmerchantable material (see figure on back of sheet). The return from salvage of expected mortality, in this instance, was greater than that from growth. This added return was a dividend paid by forest management.

July 1948 Paul Zehngraff and S. R. Gevorkiantz, Silviculturists

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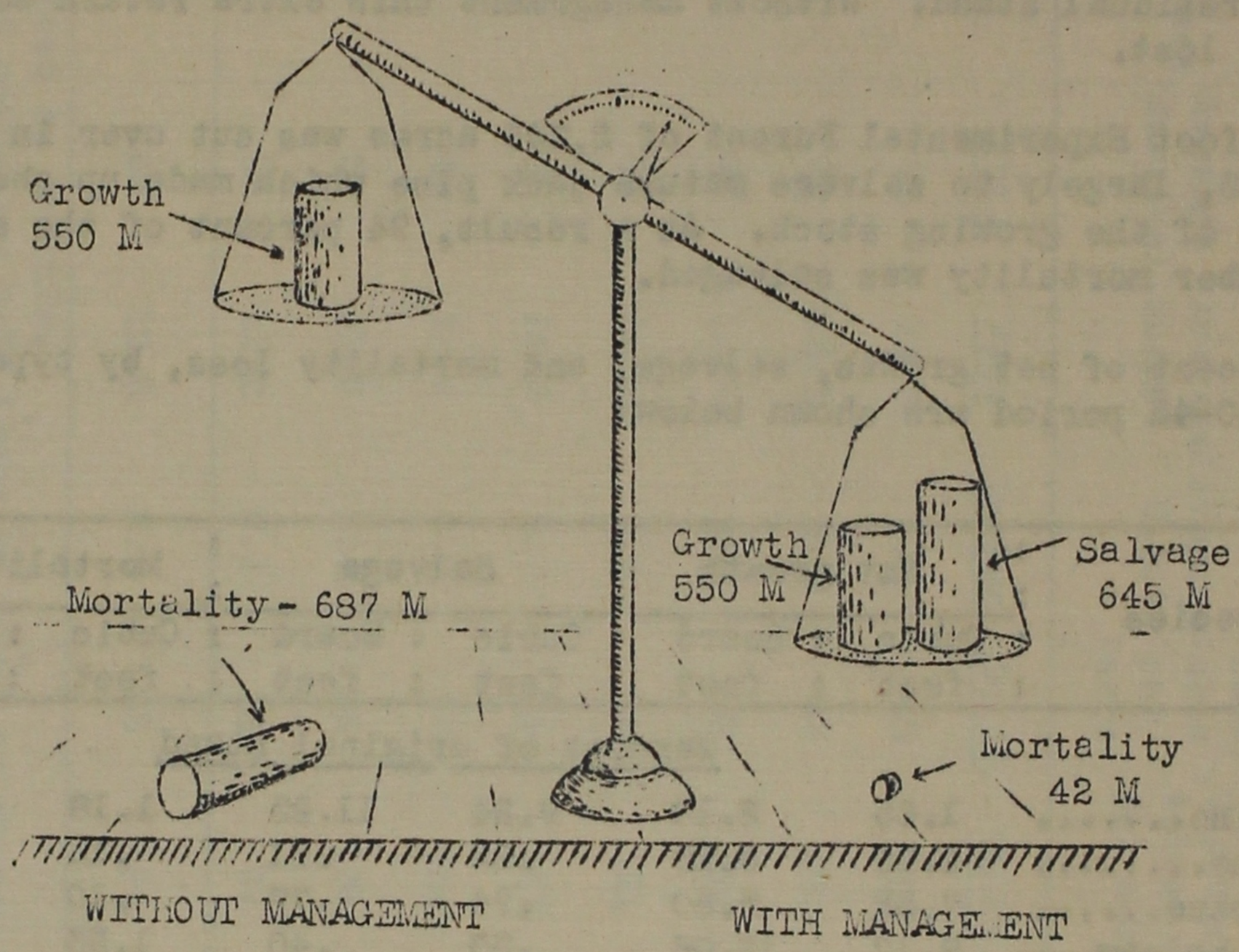
MORTALITY LOSS OR SALVAGE - WHICH?



This return would not have been possible had the forest been left unmanaged.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 298

The Right Kind of Black Spruce Growing Stock Pays Off

It has been recognized for some time that partial cuttings in black spruce swamps must be light if they are to produce good growth and avoid heavy mortality. Earlier studies by the Station suggest that "cuttings heavier than 30 percent lead to increased mortality from all causes and a reduction in annual growth."

That the kind of growing stock is of equal or greater importance than the amount is emphasized by 5-year growth data on three recently remeasured series of plots in Koochiching County, Minnesota, established in 1941 in cooperation with the Minnesota Forest Service. These cuttings removed from 8 to 12 cords per acre or about 30 percent of the original volume.

In one stand (series 1 and 2 in table), the trees (over 3.6 inches d.b.h.) varied in age from 57 to 156 years. The larger trees were nearly all over 130 years old, but younger, thrifty trees were well represented in the small and medium sizes.

The second stand (series 3 in table) had a similar volume and was located on a slightly better site, although in both cases the site would be classed as medium. The second stand lacked, however, the good distribution of young, vigorous trees. The larger trees ranged in age from 133 to 168 years, and the youngest tree from which a core was taken was 105 years old.

The net annual increment per acre for the 5-year period after cutting after deducting for mortality but including ingrowth is given below:

Cutting series	1941 residual stand		Annual growth			
	Basal area	Volume	Basal area		Volume	
	Sq. ft.	Cords	Sq. ft.	Percent	Cords	Percent
1	99	21.4	2.7	2.7	0.80	3.7
2	87	18.4	2.9	3.4	.72	3.9
3	83	20.5	.9	1.1	.34	1.7

Although volumes of the residual stands were quite comparable, series 1 and 2 showed over twice as much growth as series 3. Mortality did not differ between the plots, but growth of merchantable trees was far poorer in series 3, which was characterized by an older, less vigorous growing stock. The stand in which series 3 is located may show greater response as time goes on, but it is doubtful that growth will approach that on the other areas.

The desirability of starting management while the stand is comparatively young and vigorous is clearly demonstrated.

L. P. Neff, Forester

July 1948

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 299

How Shelterbelts Benefit Crops

Measurements made between 1935 and 1941 on over 300 fields in the Central and Northern Plains, each field protected by a shelterbelt, leave no doubt that shelterbelts result in increased crop yields, which will be more profitable if the belts are kept reasonably narrow. Attempt is made here to show how the benefits are produced, rather than their exact amounts. Much depends on the proper placement of field shelterbelts for most benefit, and such tree plantings will differ from the type ordinarily used to protect farmsteads.

There have been many theories as to why crops are benefited by shelterbelts, among the most common being that they reduce wind velocity and therefore reduce evaporation, thus conserving moisture. The crop increases are the result of "moisture conservation" in another sense, dependent on the occurrence of snowfall in large amounts, on the movement of snow, and on the mechanical effectiveness of the shelterbelt in holding snow.

In the Northern and Central Plains, shelterbelts benefit both corn and small grains (principally wheat). The greatest benefit is from a belt on the north side of a field. Next in beneficial effect are belts on the west, while belts to the south are third in effectiveness. Belts east of fields show some benefit, but barely enough to offset the injurious competition occurring in the narrow area close to the trees.

The commonest winter winds are from the northwest, with winds of highest velocity more northerly than westerly, as at Fargo, North Dakota. These winds largely determine where the most snow will lie, and crop benefits to the south and east of shelterbelts result from the normal drifting of snow into those areas. If there is no disturbing cross-wind, snow is "held" where it fell on a considerable area south of an east-west belt or east of a north-south belt. The crop area benefited may be as wide as 10 tree-heights or in a strip about 400 feet wide for an average belt 40 feet high.

Crop benefits to the north of shelterbelts are due partly to drifts formed to windward. Fields on both sides of a belt may be benefited, but for the best use of snow it should be "blown through" the belt and not remain too close to the trees. Tall belts with 3-5 rows of trees permit this and may show more uniform wind reduction than do the very "heavy" belts which are preferred for farmstead protection.

Snow-retention effects of shelterbelts are more pronounced in Northern Plains than to the south and indicate what may be expected in Minnesota. The results are probably not applicable west of the 100th Meridian.

July 1948

C. G. Bates, Silviculturist

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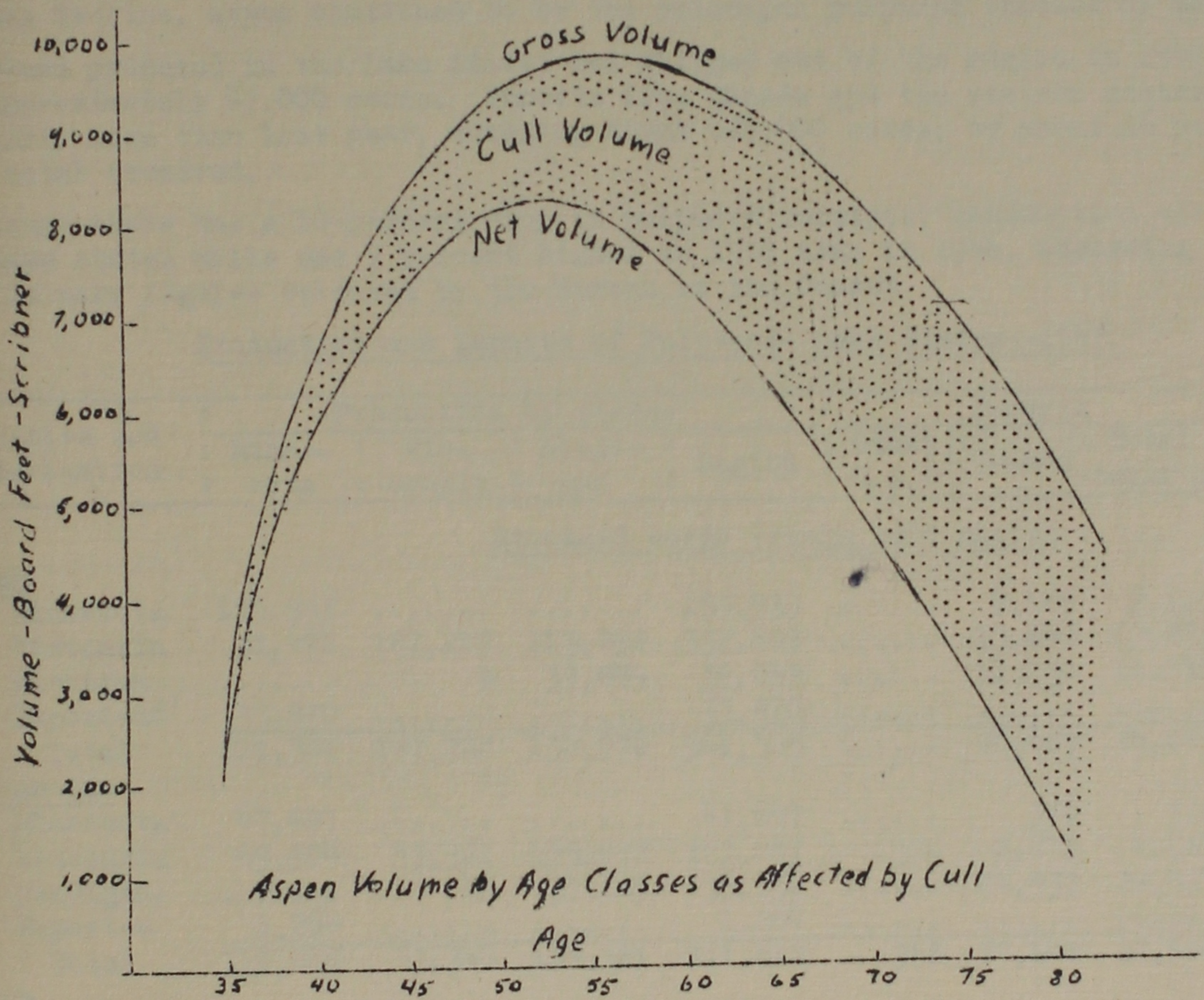
TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 300

Yields of Aspen in Unmanaged Stands

The yield of aspen is considerably lower than that of most commercial forest species according to studies made on the Chippewa National Forest in northern Minnesota during the past decade. Earlier estimates of volume yields were too high, chiefly because proper weight was not given to: (a) the high natural mortality with increasing age; and (b) the natural slowdown in growth with age.

The chart below shows the gross, net, and "cull" volumes of trees at least 7 inches in d.b.h. to a minimum top diameter of 6 inches inside bark computed from several logging studies in well-stocked stands on average good site.



The "cull" includes the entire volume of all 8-foot logs which were left in the woods because of excessive rot, as well as the actual rot in the merchantable logs. It is evident from these data that aspen yield reaches its peak rather early and that monetary returns decrease very rapidly thereafter. It should be stressed that the above data are from unmanaged stands. Through proper management, the cull volume can be kept at a minimum and net volumes proportionally increased.

July 1948

Paul Zehngraff, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 301

Lake States Pulpwood Production Declines in 1947

A recent survey made by the Station shows that Lake States pulpwood production amounted to approximately 2,024,000 cords during 1947, compared with 2,250,000 cords in 1946 -- a decrease of approximately 10 percent. The decrease in production was about 20 percent in Michigan and about 13 percent in Minnesota. In Wisconsin, on the other hand, pulpwood production increased about 15 percent over the previous year.

Spruce, balsam, pine, tamarack, and miscellaneous hardwoods accounted for about the same amount of pulpwood as in 1946. Hemlock and aspen production, on the other hand, dropped 37 percent and 21 percent, respectively, below that of 1946. In spite of the decline, aspen continued to be the principal pulpwood species of the region.

Pulpwood produced in the Lake States and shipped out of the region in 1947 amounted to approximately 47,000 cords. Imports from Canada and the western states were slightly less than last year, totaling about 686,000 cords, or about 26 percent of the total received.

Although there was a 10-percent drop in pulpwood receipts, consumption of pulpwood at Lake States mills was 7 percent higher in 1947 than in 1946, according to preliminary figures released by the Bureau of the Census.

Production and Imports of Pulpwood--Lake States--1947

Species and destination	Production by states				Imports			Total receipts
	Minnesota	Wisconsin	Michigan	Region	Other U.S.[1]	Canada	Total imports	
	Standard cords (rough wood basis)							
Aspen								
To Minnesota	155,933	.....	.....	155,933	.....	2,115	2,115	158,048
Wisconsin	31,498	187,219	113,892	332,609	.....	13,240	13,240	345,849
Michigan	.....	9	39,084	39,093	.....	11,330	11,330	50,423
Exported[2]	33,870	.....	.....	33,870	.....	.....	.....	.....
Total	221,301	187,228	152,976	561,505	.....	26,685	26,685	554,320
Balsam fir								
To Minnesota	47,697	.....	.....	47,697	.....	376	376	48,073
Wisconsin	69,904	53,321	103,872	227,097	358	2,229	2,587	229,684
Michigan	.....	45	35,509	35,554	.....	24,537	24,537	60,091
Exported	1,264	.....	.....	1,264	.....	.....	.....	.....
Total	118,865	53,366	139,381	311,612	358	27,142	27,500	337,848
Birch								
To Minnesota	.....	.....	.....	.....	.....	.....	.....	.....
Wisconsin	39	8,059	5,373	13,471	.....	.....	.....	13,471
Michigan	.....	.....	715	715	.....	.....	.....	715
Total	39	8,059	6,088	14,186	.....	.....	.....	14,186
Hemlock								
To Minnesota	.....	.....	.....	.....	.....	.....	.....	.....
Wisconsin	.....	50,162	84,054	134,216	.....	.....	.....	134,216
Michigan	.....	.....	64,454	64,454	.....	.....	.....	64,454
Total	.....	50,162	148,508	198,670	.....	.....	.....	198,670

(Over)

Species and destination	Production by states				Imports			Total receipts
	Minnesota	Wisconsin	Michigan	Region	Other U.S. 1/	Canada	Total imports	
	Standard cords (rough wood basis)							
Pine								
To Minnesota	119,482	.....	.....	119,482	.....	40,671	40,671	160,153
Wisconsin	125,631	115,528	25,373	266,532	20,137	5,466	25,603	292,135
Michigan	20,616	41,909	61,084	123,609	.....	17,002	17,002	140,611
Exported	13	.....	.....	13	.....	.....	.....	....
Total	265,742	157,437	86,457	509,636	20,137	63,139	83,276	592,89
Spruce								
To Minnesota	111,469	.....	.....	111,469	.....	10,741	10,741	122,210
Wisconsin	102,150	30,674	105,454	238,278	3,954	444,867	448,821	687,09
Michigan	.....	40	28,154	28,194	.....	89,391	89,391	117,55
Exported	11,391	.....	.....	11,391	.....	.....	.....	.....
Total	225,010	30,714	133,608	389,332	3,954	544,999	548,953	926,84
Tamarack								
To Minnesota	6,065	.....	.....	6,065	.....	.....	.....	6,05
Wisconsin	12,154	5,448	1,372	18,974	.....	.....	.....	18,94
Michigan	.....	.....	555	555	.....	.....	.....	55
Total	18,219	5,448	1,927	25,594	.....	.....	.....	25,54
Misc. Hardwoods								
To Minnesota	.....	.....	.....	.....	.....	.....	.....	.....
Wisconsin	.....	51	8	59	.....	.....	.....	9
Michigan	.....	.....	9,681	9,681	.....	.....	.....	9,6
Total	.....	51	9,689	9,740	.....	.....	.....	9,7
Waste (Slabs, veneer cores, etc.)								
To Minnesota	2,554	.....	.....	2,554	.....	.....	.....	2,5
Wisconsin	.....	757	.....	757	.....	.....	.....	7
Michigan	.....	.....	.....	.....	.....	.....	.....	.....
Total	2,554	757	.....	3,311	.....	.....	.....	3.3
All species								
To Minnesota	443,200	.....	.....	443,200	.....	53,903	53,903	497,1
Wisconsin	341,376	451,219	439,398	1,231,993	24,449	465,802	490,251	1,722,24
Michigan	20,616	42,003	239,236	301,855	.....	142,260	142,260	444,11
Exported	46,538	.....	.....	46,538	.....	.....	.....	.....
Total	851,730	493,222	678,634	2,023,586	24,449	661,965	686,414	2,663,48

1/ Montana, South Dakota, Idaho, Colorado.

2/ Pulpwood produced in the states and shipped to other parts of the United States.

October 1948

A. G. Horn, Forest Economist

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 302

More Ties on Better Sites

As the productive capacity of forest land improves, more and better grades of railroad cross ties are obtained per acre of similarly stocked area. The effect of site is more striking than is generally assumed. Recent studies of timber yields of mixed-oak farmwoods in southwestern Wisconsin have indicated the following yields of cross ties obtainable from well-stocked stands (predominantly red oak) at 100 years of age:

Site quality	Average d.b.h. of dominant trees	8-foot ties		Grades 3, 4, 5
		Per acre	Per tree	
	Inches	Number	Number	Percent
Very poor	10.4	100	1.0	38
Poor	12.3	172	1.4	52
Medium	14.1	273	2.3	62
Good	15.9	316	3.0	78
Very good	17.7	360	3.8	88

As compared to very poor sites, medium sites produce more than 2-1/2 times and very good sites more than 3-1/2 times as many cross ties per acre. The proportion of grades 3, 4, and 5, also increases rapidly with the increase in site quality. The probable returns per acre, therefore, are increased by both quantity and quality of ties produced on the better sites.

October 1948

S. R. Gevorkiantz, Silviculturist

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 303

Distribution of Minnesota Farm Woodland

In 1945, the 188,952 farms in Minnesota included more than 4-1/4 million acres of woodland or about a quarter of the forest area of the State. The average woodland acreage per farm is about 22-1/2 acres. Considering only farms with woodland, the average is about 53 acres.

How this farm woodland is distributed throughout the State should be of interest to foresters, agricultural leaders, and conservationists.

Table 1.--Distribution of Minnesota farm woodland, by area 1/

Area 2/	Total farms	Farms with woodlands		Area in farm woodland	Average area in woodland: All farms	Average area in woodland: Farms with woodland
	Number	Number	Percent	Acres	Acres	Acres
1. Southwestern Minnesota....	18,986	1,398	7	24,746	1.3	17.7
2. Upper Minnesota Valley....	18,421	1,626	9	45,072	2.4	27.7
3. Mankato.....	20,248	5,290	26	148,629	7.3	28.1
4. Big Woods.....	17,135	7,005	41	208,051	12.1	29.7
5. Twin Cities.....	10,220	3,980	39	142,652	14.0	35.8
6. Red River Valley.....	20,839	10,158	49	681,289	32.7	67.1
7. Lake Region.....	12,578	6,281	50	289,591	23.0	46.1
8. Southeastern Minnesota....	18,203	8,361	46	464,400	25.5	55.5
9. Cambridge.....	7,235	4,205	58	214,569	29.7	51.0
10. Little Falls.....	14,339	8,508	59	477,690	33.3	56.1
11. Northeastern Minnesota....	13,019	9,449	73	530,697	40.8	56.2
12. Central Pine.....	15,712	12,341	79	915,384	58.3	74.2
13. Rainy River.....	2,017	1,620	80	122,583	60.8	75.7
Total or Average	188,952	80,222	42	4,265,353	22.6	53.2

1/ U. S. Census of Agriculture, 1945.
2/ For this analysis the State was divided into groups of counties similar in topography, soil conditions, timber types, and climate. A map showing boundaries of these areas will be found on the back of this page.

The woodland area is well distributed over all of Minnesota except the extreme southwest corner of the State. The timbered area on the average farm is sufficient, under good management, to supply many of the farmer's needs for fuel, posts, and rough lumber.

October 1948

John R. Neetzel, Forester

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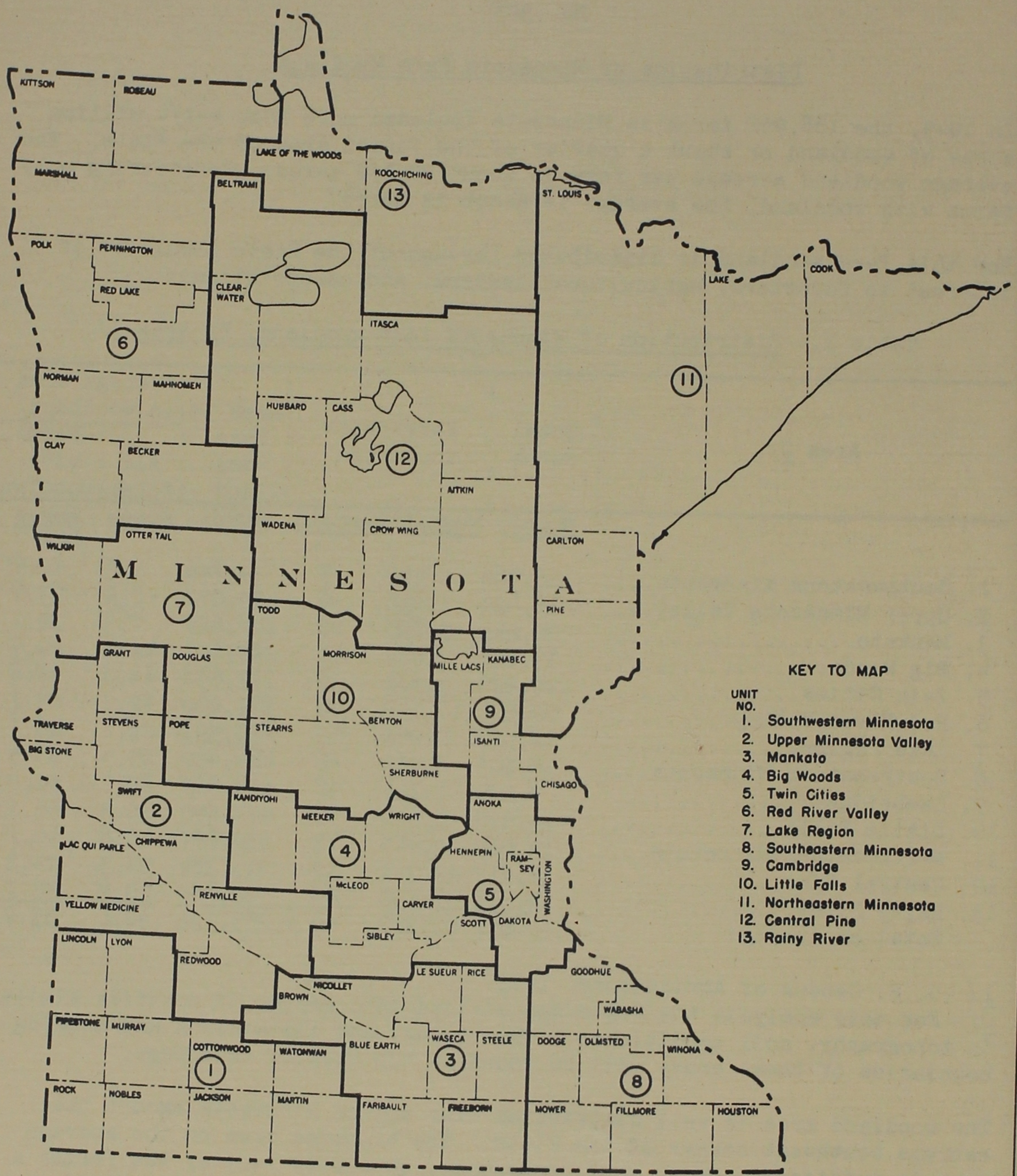
MINNESOTA FARM WOODLAND UNITS



KEY TO MAP

UNIT NO.

1. Southwestern Minnesota
2. Upper Minnesota Valley
3. Mankato
4. Big Woods
5. Twin Cities
6. Red River Valley
7. Lake Region
8. Southeastern Minnesota
9. Cambridge
10. Little Falls
11. Northeastern Minnesota
12. Central Pine
13. Rainy River

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 304

Logging Costs of Aspen

For logging plans, timber appraisals, and in forest management work it is often desirable to know how much time is needed to cut individual trees or for cutting in various stands. By applying the figures from the following table to a stand table for the aspen area to be logged, an estimate can be made of the time required for the entire cutting operation.

Time Required in Cutting Aspen Trees of Various Diameters

Activity	Tree diameter (b.h.) - Inches										
	5	6	7	8	9	10	11	12	13	14	15
	Time in seconds										
Felling	45	52	65	90	115	145	185	225	270	320	375
Limbing and lopping 1/	25	45	65	95	130	165	210	260	320	400	525
Bucking 2/	105	131	172	229	301	381	466	566	671	776	876
Miscellaneous 3/	79	112	143	157	174	198	214	229	251	269	298
Total	254	340	445	571	720	889	1,075	1,280	1,512	1,765	2,074
	Basis: Number of trees										
	4	5	9	19	25	21	21	17	15	5	2

1/ Includes bunching of bolts in piles of two or three pieces at point of felling.

2/ Includes measuring of bolts.

3/ Includes time for walking between trees, cutting brush in preparation for felling, hang-up time in felling, other time between operations of felling, bucking, and limbing.

The data for this table were collected in connection with logging of a 52-year-old stand of aspen on the Pike Bay Experimental Forest near Cass Lake, Minnesota. The cutting was done by men working singly and using bow saws. Utilization of trees was to a 4-inch top and logs were all cut into 100-inch lengths. The operation was carried on during the winter months.

Zigmond A. Zasada, Forest Economist
Paul J. Zehngraff, Silviculturist

October 1948

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 305

Winter Damage to Scotch Pine in Northern Minnesota

Many conifers, especially exotics, were seriously injured in Minnesota during the winter of 1947-48. Observations on the Chippewa National Forest in northern Minnesota disclose that foliage injury to Scotch pine varied greatly according to seed origin. Trees grown from seed native to localities in the same climatic zone as Cass Lake were largely uninjured, but those grown from seed originating in milder climates had a large part of their needles killed, as shown in the table below:

Country of origin	Sources	Degree of winter injury			
		None	Light 1/	Heavy 2/	Dead
	Number	Percent	Percent	Percent	Percent
	Localities in same climatic zone as Chippewa National Forest				
Romania	1	100	..	..	..
Finland	1	97	3	..	1
Poland 3/	7	94	1	..	..
Sweden	2	92	6	2	..
Norway	5	92	4	1	3
Riga variety 3/	2	90	5	3	2
East Prussia	1	81	17	1	1
Russia	1	73	23	3	1
	Localities with climate milder than Chippewa National Forest				
Romania	1	39	43	17	1
Poland	1	25	63	10	2
Hungary	1	20	38	40	2
France 3/	3	10	21	62	7
Germany 4/	10	7	8	70	15
Denmark	1	5	27	63	5
Holland	1	4	79	11	6
Scotland	1	4	28	68	..
Austria	1	2	2	72	24
All lots (Basis: 4,800 trees)	40	52	13	28	7

1/ Less than one-half of foliage brown.
2/ More than one-half of foliage brown.
3/ Includes one American collection, probably of this original source.
4/ Includes 9 American collections, probably of this original source.

The plantations include trees 19, 17, and 12 years old (from seed). Because of similar responses of similar origins, regardless of age, all have been grouped together in one table.

October 1948

Paul O. Rudolf, Silviculturist

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 306

Dense Seed Spots Produce Spindly Jack Pine Seedlings

Sowing seeds in prepared spots in the field, sometimes used when planting stock is not available or to save the cost of nursery stock, is an old method of reforestation. To compensate for heavy mortality, several seeds are sown per spot, with the result that some usually have several seedlings. Observations on a 10-year-old jack pine seeding on the Superior National Forest in northeastern Minnesota show that as the number of trees per spot increases (1) both average height and diameter of the seedlings decrease and (2) height and spindliness of the tallest seedlings per spot increases.

Development of Jack Pine According to Number of Trees per Seed Spot 1/

Trees per spot 2/	Average height	Average maximum height	Average d.b.h.	Average maximum d.b.h.	Spindliness index 3/	Basis spots
Number	Feet	Feet	Inches	Inches	Ratio	Number
1	14.2	14.2	2.3	2.3	6.2	24
2-3	13.3	14.7	1.8	2.2	6.7	13
4-5	12.4	14.5	1.4	2.0	7.2	4
6-9	11.9	15.7	1.3	2.1	7.5	7

1/ Established at the rate of 900 spots per acre; 83 percent were stocked at the end of 10 years.
2/ About 25 seeds per spot sown.
3/ Ratio of maximum height to maximum diameter.

If the better trees on the multiple spots are to grow and develop satisfactorily indications are that a noncommercial thinning will be necessary. This will, undoubtedly, eliminate any monetary saving of seeding over planting.

In future seed-spotting it would seem better to sow more spots per acre and use much less seed per spot. Although this would increase the labor cost, it would save on seed and might obviate the need for a noncommercial thinning.

January 1949

E. I. Roe, Silviculturist

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 307

Porcupine Damage to Forest Plantations

That porcupines may seriously damage forest trees is generally known, but little information is available as to the size of trees which porcupines feed upon. Observations in some 10- to 15-year-old Lake States plantations indicate that porcupines prefer the larger trees, particularly those over 3 inches in diameter breast high and 13 feet in height - see table below:

Scotch Pines of Various Sizes Injured by Porcupines in Northeastern Minnesota

Diameter breast high	Trees in size class injured	Total height	Trees in size class injured
Inches	Percent	Feet	Percent
Under 3	1.2	Under 10	4.4
3 - 4	14.7	10 - 13	4.8
5 - 6	30.4	14 - 16	15.4
7	50.0	17 - 20	36.6

Study of a jack pine plantation in northern Wisconsin and a Scotch pine plantation in lower Michigan showed the same preference of porcupines for trees above these minimum sizes, and observations in 30- to 40-year-old plantations further corroborated the porcupines' liking for the larger more vigorous trees.

The practical value of these observations is this: Plantations of species which porcupines like, such as jack pine, white pine, or tamarack, probably will need protection--where porcupines are common--beginning about the time the trees reach 3 inches in diameter. Needs and plans for control can, therefore, be determined before damage actually starts.

January 1949 Paul O. Rudolf, Silviculturist

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 308

Proportion of Various Rough Products in Second-Growth Stands

For good stumpage appraisal, one should know how the various sizes of bolts or cut products are distributed in the standing timber. The table below gives a rough guide for most pulpwood stands (softwoods and aspen) in the Lake States, if reasonably well stocked and even aged. It assumes complete utilization to a 4-inch top (inside bark) with no allowance for defect.

Proportion of Total Gross Merchantable Volume of Different Products in 100-inch Bolts

Size class of stand	Average stand diameter at breast height	Percent total cordwood volume, by products			
		Pulpwood 4- to 6-inch top d.i.b.	Small box bolts 6- to 8-inch top d.i.b.	Large box bolts 8- to 10-inch top d.i.b.	Sawlogs 10 inches and larger
	Inches	Percent	Percent	Percent	Percent
Small pole	5	75	20	5	..
	6	59	31	9	1
Large pole	7	40	41	15	4
	8	27	43	22	8
Small saw timber	9	18	38	30	14
	10	11	29	38	22
	11	7	21	40	32
	12	5	16	36	43

January 1949

S. R. Gevorkiantz, Silviculturist

AINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 309

Minnesota Leads Lake States in 1947 Pole Production

A recent canvass by the Lake States Forest Experiment Station shows that Minnesota in 1947 produced approximately 220,000 utility poles, representing about 73 percent of the total output of poles in the Lake States (see table). This continues the trend of recent years in which Minnesota has taken the lead over Michigan, formerly the chief pole producer in the Lake States. In 1947, Michigan ranked second with about 64,000 poles, and Wisconsin third with approximately 16,000 poles.

Pole production on a regional basis has remained fairly stable. About a decade ago, Lake States pole production amounted to approximately 260,000 poles (all cedar) as compared to about 300,000 in 1947. The increase last year was due primarily to a larger output of jack pine and a few red pine poles in Minnesota.

Pole Production, by States and Forest-Survey Units -- Calendar Year 1947

Minnesota		Wisconsin		Michigan	
Unit	Number of poles	Unit	Number of poles	Unit	Number of poles
Northeast.....	51,000	Northeast..	14,000	Upper Peninsula	
Central Pine..	47,000	Northwest..	500	East Half.....	43,000
Rainy River...	113,000	Central....	2,000	West Half.....	19,000
Hardwood.....	.....	Southwest..	.....	Lower Peninsula	
Prairie.....	10,000	.....	.....	North Half.....	2,000
.....	.....	.....	.....	South Half.....	.....
Total.....	221,000	Total...	16,500	Total.....	64,000

Information on pole production was obtained from pole distributors and from a check of railroad carloadings in the pole-producing area. In Minnesota most of the cedar poles were produced in the Rainy River area, while most of the pine poles (almost one-third of the State production) came from the Central Pine and Northeast areas of the State. Pole production in Michigan and Wisconsin was entirely cedar. In Michigan, the majority of poles were cut in the East Half of the Upper Peninsula, while northeastern Wisconsin accounted for most of that State's production.

January 1949

A. G. Horn, Forest Economist

AINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 310

Growth of a Managed Pine Forest

How much wood is produced annually in a managed pine forest? Some light is shed on this question by permanent growth plots established in 1940 on the Cutfoot Experimental Forest in northern Minnesota. This 2,346-acre tract represents average conditions of the better stocked pine forests in Minnesota. Because the sample measured included 10 percent of the area, the information is considered representative of what might be expected under management of fairly large tracts.

The net annual growth in board feet was greatest for the older pine and least for the hardwoods; in cubic feet, however, the greatest growth was made by the younger pine and least by the oldest pine (table 1). On a percentage basis, spruce-balsam fir made the greatest growth and jack pine, which is mostly mature, made the least (table 2). Other species are intermediate.

(Over)

January 1949 Paul Zehngraff, Silviculturist

NTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Table 1.--Area, volume, and net annual growth per acre, by forest types and age classes - 1941 to 1945

Type	Age classes	Area	1940 growing stock			Net annual growth		
	Years	Acres	Cubic feet 1/	Board feet 2/	Add'l. cords 3/	Cubic feet	Board feet	Add'l. cords
Pine.....	60-80	1,180	2,755	9,015	7.1	54.6	303	.01
Pine.....	40-60	719	1,302	2,636	6.1	82.0	199	.26
Pine.....	20-40	75	810	2,109	4.3	98.6	141	.66
Swamp.....	40-60	163	1,129	2,142	7.2	66.2	171	.38
Hardwood.....	40-60	96	938	2,010	5.4	60.4	100	.40
Nonproductive	.....	113	143	301	.9	10.6	19	.07
Average per acre ...		...	1,904	5,655	6.4	63.4	235	.16

1/ Total volume to 3-inch top on all trees 3.6 inches d.b.h. and larger.
2/ Total volume (Scribner) to 6-inch top on trees 7.6 inches d.b.h. and larger.
3/ Total volume to 3-inch top in trees 3.6 inches to 7.5 inches d.b.h., plus volume above 6-inch top in trees 7.6 inches d.b.h. and larger.

Table 2.--Net annual growth by species, entire tract - 1941 to 1945

Species	1940 growing stock			Net annual growth					
				Cubic-foot volume		Board-foot volume		Cordwood volume	
	M cu.ft.	M bd.ft.	Add'l. cords	M cu.ft.	Percent	M bd.ft.	Percent	Add'l. cords	Percent
Red pine...	2,036	7,401	6,173	83.8	4.1	383.8	5.2	117	1.9
Jack pine..	1,989	5,173	6,019	32.8	1.7	108.6	2.1	22	.4
White pine.	71	258	191	5.4	7.5	15.0	5.7	25	13.0
Spruce-balsam...	83	115	651	7.6	9.2	13.9	12.0	57	8.7
Cedar-tamarack	55	104	362	3.8	6.9	9.6	9.0	21	6.0
Hardwoods..	205	214	1,529	15.3	7.4	19.6	9.0	122	8.0
Totals...	4,466	13,265	14,925	148.7	3.3	550.5	4.2	364	2.4

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 311

When Does a Red Pine Reach Highest Value?

Forest owners are inclined to overlook the potential values of a forest stand during times of good market conditions. "Pay" trees are liquidated before they reach their highest value and earning power. As a result, the false impression is created that timber production is a poor investment.

The curves on the chart on the reverse side of this Note, which are the result of several tree development and utilization studies in northern Minnesota, show the value of a well-developed red pine tree at different ages and diameters. Values are based on present average stumpage prices.1/

The upper curve shows the value with completely integrated utilization. (Note how it rises much more sharply than the height growth of the tree.) The second curve shows the value in a combined sawlog and pulpwood operation. The third (lowest) curve shows the value if used altogether for pulpwood.

The chart emphasizes that a stand of trees should be managed and utilized for quality production. Forest management should strive to develop as many high-quality trees as possible, since these are the profit makers for the owner. The profit trees do not reach their highest value until quite late in life.

(Over)

1/ Sawlogs = $15.00 per M b.m. Pulpwood = $2.00 per cord.
Posts = 3 cents each.

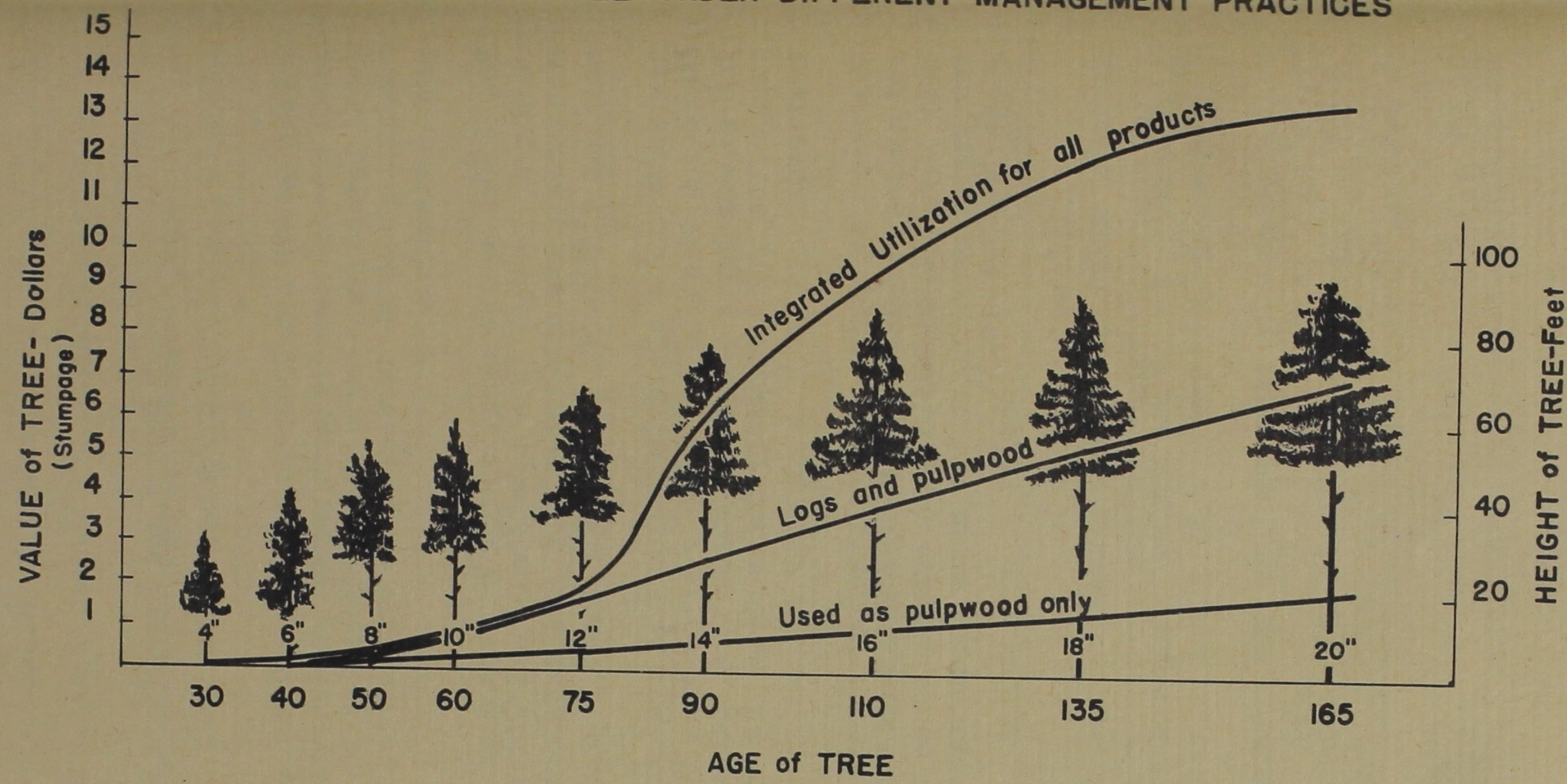
20' poles	= 1½ cents per lin. ft.	40' piling	= 15 cents per lin. ft.
35' "	= 3 " " " "	50' "	= 18 " " " "
45' "	= 3½ " " " "	60' "	= 20 " " " "

Paul Zehngraff, Silviculturist
Zigmond A. Zasada, Forest Economist

April 1949

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TOTAL VALUE OF A RED PINE TREE UNDER DIFFERENT MANAGEMENT PRACTICES



PRODUCTS		(Upper Curve)				Integrated Management for all products				
Posts	pcs.	1	1	1	-	-	-	-	-	-
Pulpwood	add. cds.	-	.06	.02	.02	.02	.02	-	-	-
Poles	lin. ft.	-	-	20	35	45	-	-	-	-
Piling	lin. ft.	-	-	-	-	-	40	50	60	60
Sawlogs	bd. ft.(Scrib.)	-	-	-	-	15	10	20	20	110
Stumpage Val.	$	.03	.12	.36	.93	1.89	6.19	9.30	12.30	13.65
PRODUCTS		(Middle Curve)				Management for sawlogs and pulpwood				
Sawlogs	bd. ft.(Scrib.)	-	-	18	54	110	175	260	360	470
Pulpwood	add. cds.	-	.06	.02	.02	.02	.02	-	-	-
Stumpage Val.	$	-	.12	.31	.86	1.70	2.67	3.90	5.40	7.05
PRODUCTS		(Lower Curve)				Management for pulpwood only				
Pulpwood	total cds.	-	.06	.09	.15	.25	.37	.52	.75	1.00
Stumpage Val.	$	-	.12	.18	.30	.50	.74	1.04	1.50	2.00

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 1, MINNESOTA
No. 312

The 1948 Forest Fire Season in the Lake States

1948 was the worst forest fire year in the Lake States since 1936. This is substantiated not only by the relative severity rating (based on burning index) which was 23.7, or 62 percent above the average of the past ten years, but by the number of fires and the area burned, which were 52 and 58 percent respectively above the 1938-47 average. Because of (1) the closure of particularly hazardous areas when burning conditions were most acute, (2) prompt action by state and federal protection agencies, and (3) an appreciable amount of good luck, no catastrophic fires developed. However, both Wisconsin and Minnesota exceeded their 10-year average burn. Michigan made the best record with only 0.09 percent of its protected area burned and an average area per fire of 8.2 acres. Minnesota suffered the most with a burn of 0.61 percent and an average fire of 74.8 acres, while on the national forests the burn amounted to 0.05 percent of the area under protection and fires averaged 9.3 acres.

The underlying cause of the severe fire season was the marked deficiency and abnormal distribution of precipitation which prevailed throughout the Lake States and eastern Canada. The spring fire season opened late (about the middle of April), became acute the last half of April, reached its peak in May, and continued well into June, normally an off month. A shorter but even more acute fire period occurred in the fall, reaching its peak in September in Michigan (August in southern lower Michigan) and October in Minnesota and Wisconsin. August was also a bad month in the southern portion of all three states. For the region as a whole, May and October were the peak months for severity of burning conditions, with June and September not far behind.

The number of fires, by causes, on 48,650,000 acres of state and private land, was as follows:

Cause	Michigan	Wisconsin	Minnesota	Total	Percent
Smoking.....	622	555	305	1,482	29.1
Railroads.....	296	337	462	1,095	21.5
Land clearing....	322	264	228	814	16.0
Miscellaneous....	230	313	140	683	13.4
Incendiary.....	48	182	28	258	5.1
Meadow burning...	...	...	245	245	4.8
Campfires.....	55	72	57	184	3.6
Lightning.....	78	86	12	176	3.5
Unknown.....	93	...	...	93	1.8
Lumbering.....	34	16	13	63	1.2
Totals.....	1,778	1,825	1,490	5,093	100.0

A summary of forest fire statistics for state and private lands is given on the back of this sheet.

J. A. Mitchell, Silviculturist

April 1949

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Summary of
STATE FOREST FIRE STATISTICS
Calendar Year - 1948

Item	Michigan	Wisconsin	Minnesota	Lake States total	10-year average 1938-1947
Area protected - acres	15,928,000	15,653,000	18,142,000	49,723,000	48,650,000
Number of fires	1,778	1,825	1,488	5,091	3,360
Area burned - acres	14,856	23,574	111,231	149,661	94,232
Estimated damage	$ 96,525	$ 95,117	$ 220,401	$ 412,043	$ 263,063
Cost: Fire prevention	$ 1,389,256	$ 868,774	$ 716,304	$ 2,974,354	$ 1,680,658
Fire suppression	$ 75,710	$ 110,983	$ 153,056	$ 339,749	$ 106,828
Total loss plus cost	$ 1,561,491	$ 1,074,874	$ 1,089,761	$ 3,726,126	$ 2,050,549
Risk of fires starting					
Number per 100,000 acres protected	11.2	11.7	8.2	10.2	6.9
Risk of fires spreading					
Size of average fire (acres)	8.4	12.9	74.8	29.4	27.3
Risk of burning					
Percent of protected area burned	0.09	0.15	0.61	0.30	0.19
Destructiveness					
Average loss per acre burned	$ 6.50	$ 4.03	$ 1.98	$ 2.75	$ 2.64
Risk of loss					
Average loss per acre protected	$ 0.006	$ 0.006	$ 0.012	$ 0.008	$ 0.006
Cost of fire prevention					
Per acre protected	$ 0.087	$ 0.056	$ 0.039	$ 0.060	$ 0.035
Cost of fire suppression					
Per fire	$ 42.58	$ 60.81	$ 102.86	$ 66.74	$ 31.26
Effectiveness of fire control					
Percent of fires under 10 acres	87.4	91.6	71.0	84.1	77.8

Note: For 1947 statistics see Technical Note No. 295.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 313

Lake States Mines Use Large Quantity of Wood

In 1947, Lake States timber operators cut approximately 7,178,000 cubic feet of round and split wood products for iron and copper mines, according to a survey recently completed by the Lake States Forest Experiment Station, in cooperation with the Forest Research Division of the Michigan College of Mining and Technology. Over 30 mining companies were contacted to obtain complete records of wood procurement.

Of the 7 million cubic feet of rough wood produced for the mines, Michigan accounted for approximately 63 percent of the total, Minnesota 32 percent, and Wisconsin 5 percent, respectively. Production in each of the states about met the needs of the mines in that State. Of the material cut, over 3 million cubic feet were mine timbers, slightly less than 2 million cubic feet were mine poles, and 2 million were mine lagging. On a regional basis, mine timbers averaged about 5.5 cubic feet per piece, mine poles about 1.5 cubic feet per piece, and mine lagging about 69 cubic feet per 4x4x8-foot cord.

Most of these rough wood products are used in the iron mines. Less than 4 percent of the total mine wood was produced for the copper mines. Total mine wood production accounted for about 1 percent of the total 1947 forest drain in the Lake States.

Production of Mine Materials, Lake States--1947

Kind of product and species	Unit of measure	Production, by states: Michigan	Wisconsin	Minnesota	Region
Mine timbers 1/					
Cedar.....	M pieces	1	..	..	1
Hemlock.....	" "	57	2	..	59
Pine.....	" "	..	..	154	154
Tamarack.....	" "	10	2	53	65
Hardwoods.....	" "	294	17	22	329
All species..		358	21	229	608
Mine poles 2/					
Cedar.....	M pieces	8	..	..	8
Hemlock.....	" "	2	1	..	3
Pine.....	" "	..	..	75	75
Tamarack.....	" "	438	99	403	940
Hardwoods.....	" "	151	13	..	164
All species..		599	113	478	1,190
Mine lagging					
Cedar.....	M cords	20	1	4	25
Other 3/.....	" "	3	..	2	5
All species..		23	1	6	30

1/ Includes the following items: stulls, props, caps, chute logs, shaft roller stock, hewed shaft timber, smelter poles. 2/ Includes cribbing, stage poles, chute poles, and smelter brands. 3/ Includes hemlock, pine, and tamarack.

A. G. Horn, Forest Economist

April 1949

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 314

Cutting Aspen Overstory Improves Growth of Young Hardwoods

That an aspen overstory reduces the stocking and the growth of young hardwoods is shown by a timber stand improvement study made in Michigan on the Upper Peninsula Experimental Forest in 1933-34. The stand at the time of treatment was primarily a mixture of aspen and sugar maple which had come up after clear cutting in 1920. The number of trees per acre in 1933 ranged from 8,000 to 12,000 over 2½ feet high and 20 to 60 over 4.5 inches d.b.h.

The stand improvement work consisted of two operations: (1) removal of all trees 4.6 inches d.b.h. and larger over the entire area, and (2) cultural cuttings which varied from block to block within the area. The latter consisted of different intensities of thinning and removal of different proportions of the aspen overstory. A check plot was left where nothing was done beyond removing the relatively few trees over 4.5 inches d.b.h.

The amount of aspen remaining after treatment had more influence on the stand than did the thinning. Growth response to the treatments varied inversely with the amount of aspen left. The following table compares hardwoods on a plot where all the aspen was removed with the hardwood understory on the check plot. On the latter plot there were 1,200 aspen per acre in 1933 and 525 in 1946.

Comparison of Hardwood on Released and Check Plots--Per-acre Basis

Year	Number of hardwoods 2 inches and over		Basal area, hardwoods 2 inches and over		Number of hardwoods 4 inches and over	
	Released	Check	Released	Check	Released	Check
	Number	Number	Sq. ft.	Sq. ft.	Number	Number
1933	80	80	1.8	2.6	0	2
1938	880	246	24.1	7.1	40	14
1946	1,232	730	64.9	22.1	280	25

Average height of dominant sugar maple on the released plot was 40 feet as compared to 34 feet on the check plot. The results indicate that for the best development of the sugar maple, the aspen should be removed as early as possible. Ordinarily this could be done soon after the aspen reaches pulpwood size. On hardwood sites the aspen often reaches this size before it is 25 years old. Thus an intermediate crop is provided without retarding the hardwoods for a very long period.

April 1949

LaMont G. Engle, Silviculturist

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 315

Cordwood in Tops of Conifers and Aspen in the Lake States

In cruising, the additional cordwood in the tops of saw-timber trees is often overlooked. This volume can be determined from the board-foot stock tables by using the factors given below. These show the number of cords above sawlog utilization, to a variable top not less than 4 inches d.i.b. They are expressed in number of rough cords per thousand board feet gross volume, Scribner rule. If board-foot volumes are wanted for International 1/4" rule, multiply the factors by the figures shown in the last column to the right. The factors within the block are for the typical range of merchantability in the Lake States.

Number of Cords in Tops per Thousand Board Feet, Scribner Rule

Tree d.b.h.	Total tree height	Merchantable height--number of 16-foot logs per tree: 1/2	1	1½	2	2½	3	3½	4	Conversion factor Int'l. ¼"
Inches	Feet									
8	30	1.96								.59
	40	3.60	.65							
	50	5.25	1.86	.89						
10	40	3.03	.41	.08						.75
	50	4.40	1.50	.55						
	60	5.80	2.35	1.12	.25	.02				
12	50	3.70	1.34	.42	.07					.80
	60	4.88	2.19	1.08	.50	.08				
	70	6.14	3.03	1.75	.91	.28	.03			
14	50	3.22	1.25	.40	.08					.85
	60	4.30	2.07	1.06	.45	.09				
	70	5.35	2.77	1.63	.86	.31	.07			
16	60	4.00	1.95	1.03	.40	.10				.88
	70	4.90	2.60	1.55	.84	.32	.08			
	80	5.88	3.22	2.03	1.32	.73	.27	.07		
18	60	3.76	1.85	.96	.35	.10				.91
	70	4.55	2.43	1.43	.80	.28	.05			
	80	5.40	3.03	1.93	1.24	.68	.27	.05		
20	60	3.58	1.72	.95	.30	.10				.92
	70	4.40	2.30	1.39	.74	.28	.05			
	80	5.15	2.81	1.83	1.12	.62	.25	.04		
22	70	4.24	2.16	1.30	.68	.26	.04			.92
	80	4.87	2.60	1.68	1.02	.55	.22	.04		
	90	5.73	3.15	2.15	1.42	.90	.55	.25	.04	
24	70	3.96	2.05	1.21	.60	.23	.03			.92
	80	4.60	2.47	1.58	.93	.52	.20	.03		
	90	5.72	2.96	1.99	1.30	.84	.44	.18	.02	
	100	6.07	3.46	2.45	1.68	1.25	.78	.48	.26	

Stump height is one foot. Merchantable height is the number of usable 16-foot logs to a variable top not less than 6 inches inside bark.

Paul C. Guilkey, Forester

April 1949

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Technical Note No. 316

Lead Adjusting Device for Circular Sawmills

All sawmills are provided with a means of adjusting the lead. This is usually accomplished by slewing the saw mandrel on the husk; a process that requires the removal of the husk cover, and an alternate setting of the screws controlling the slew of the mandrel and testing the lead. As most sawyers prefer to set the mandrel with the saw stationary, but test the lead with the saw turning, it is a trial and error process requiring several minutes.

A simple device by which the lead can be adjusted quickly without stopping the saw is shown in the sketches on back of this sheet. It consists of a horizontal plate on one end of which is a bracket consisting of two vertical plates. Between these plates is a round disc with the bore threaded to run on a standard 3/4-inch machine bolt. A rod 3/4" x 12" threaded its entire length is run through the bracket and screwed into the disc lying between the two vertical plates of the bracket. The other end of the rod is fastened to the husk leg by 3/4-inch nuts. The plate must be securely bolted to the mud sill or husk foundation. The bolt anchoring the husk leg should be welded to the plate. Place the three legs not connected to the adjusting device on greased metal bearing surfaces in order to permit movement of the husk. The device should be located at the log deck end of the husk on the driven pulley side. The leg diagonally across the husk should be held in place by a tie bolt to the way timber under the carriage track. For small adjustments this tie bolt need not be loosened. The tie bolt on the sawyer's end of the husk may be omitted. This device has proven very useful on the Michigan State College mill.

Steps to adjust the lead are as follows:

1. Loosen the 4 bolts anchoring the husk.
2. Turn disc by inserting lever in holes and turning to side until lead is as required.
3. Tighten anchor bolts.

On a mill with a husk frame 8 feet long, a full revolution of the disc will change the lead of the saw 1/4 inch in 20 feet.

This device may be used on mills without husk legs by placing a metal slide plate under each corner of the husk and attached to the husk. The threaded adjusting rod would then be fastened to the husk frame.

(over)

July 1949

J. W. Creighton, Agent

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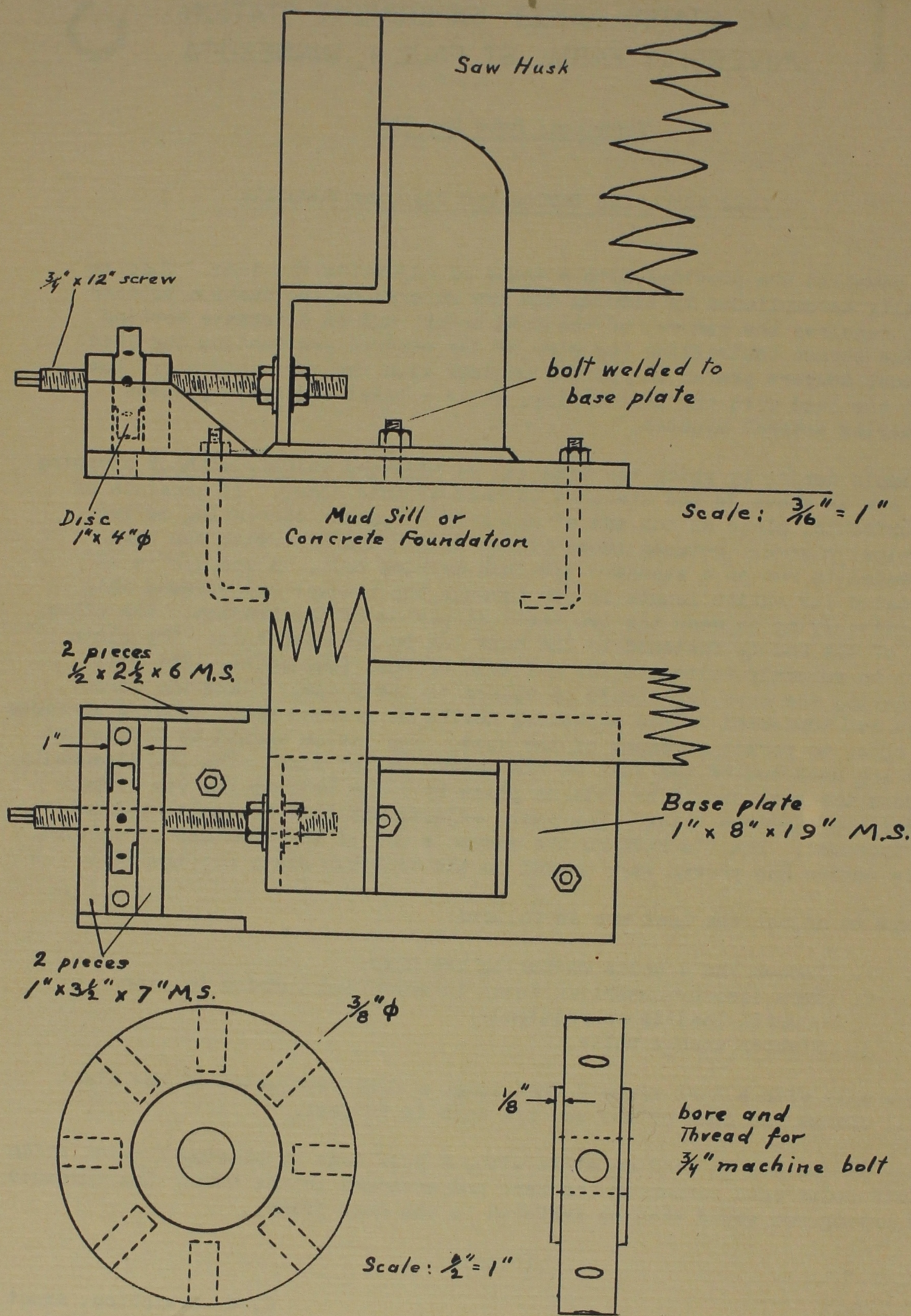
Saw Husk
3/4" x 12" screw
bolt welded to base plate
Disc 1" x 4" ϕ
Mud Sill or Concrete Foundation
Scale: 3/16" = 1"
2 pieces 1/2 x 2 1/2 x 6 M.S.
1"
Base plate 1" x 8" x 19" M.S.
2 pieces 1" x 3 1/2" x 7" M.S.
3/8" ϕ
1/8"
bore and Thread for 3/4" machine bolt
Scale: 1/2" = 1"

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 1, MINNESOTA
No. 317

Distribution of Lumber Cut from Southern Minnesota

About 35 million board feet of lumber were harvested annually from the southern 62 counties of Minnesota during 1943, 1944, and 1945.

It is interesting to note that the 12 counties with the heaviest average cut per acre of woodland (underlined in the accompanying table) are largely the moderately timbered counties in south-central Minnesota rather than the heavier timbered counties in the southeastern or central part of the State. A considerable part of the heavier cut in the Minnesota and Blue Earth River drainage was from cottonwood, soft maple, oak, and associated species in the river bottoms.

The tabulation, by counties, is given in the following table:

Southern Minnesota counties	Area farm woodland 1945 1/	Sawmills in 1945 2/	Average annual volume of lumber cut from woodland 1943 to 1945, inclusive 3/	
			Total cut	Cut per acre of woodland
	Acres	Number	M bd. ft.	Bd. ft.
Anoka.....	42,733	9	140	3
Benton.....	43,569	8	1,319	30
Bigstone.....	1,628	0	0	0
Blue Earth.....	34,797	24	897	26
Brown.....	12,266	18	830	68
Carver.....	48,679	17	805	17
Chippewa.....	2,969	3	8	3
Chisago.....	73,236	9	1,473	20
Cottonwood.....	3,508	0	0	0
Dakota.....	27,627	4	33	1
Dodge.....	7,971	11	177	22
Douglas.....	40,538	16	337	8
Faribault.....	11,025	13	434	39
Fillmore.....	71,398	41	1,458	20
Freeborn.....	7,112	12	427	60
Goodhue.....	49,483	20	1,639	33
Grant.....	3,263	0	0	0
Hennepin.....	38,380	12	416	11
Houston.....	125,203	35	2,434	19
Isanti.....	65,091	14	1,285	20
Jackson.....	3,359	5	280	83
Kanabec.....	41,328	13	711	17
Kandiyohi.....	19,468	16	116	6
Le Sueur.....	20,785	25	921	44
Lac qui Parle....	6,316	2	23	4

(Over)

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John R. Neetzel, Forester

July 1949

Southern Minnesota counties	Area farm woodland 1945 1/	Sawmills in 1945 2/	Average annual volume of lumber cut from woodland 1943 to 1945, inclusive 3/	
			Total cut	Cut per acre of woodland
	Acres	Number	M bd. ft.	Bd. ft.
Lincoln.....	1,409	0	0	0
Lyon.....	3,873	1	0	0
McLeod.....	18,079	9	684	38
Martin.....	3,535	2	201	57
Meeker.....	20,322	11	345	17
Mille Lacs.....	34,914	19	1,340	38
Morrison.....	130,425	41	2,694	21
Mower.....	10,621	8	150	14
Murray.....	2,853	1	0	0
Nicollet.....	18,666	19	747	40
Nobles.....	1,777	1	0	0
Olmsted.....	32,316	19	1,206	37
Ottertail.....	234,765	57	2,379	10
Pipestone.....	293	0	0	0
Pope.....	11,558	12	95	8
Ramsey.....	4,770	0	0	0
Redwood.....	6,161	4	38	6
Renville.....	10,886	12	327	30
Rice.....	26,659	16	569	21
Rock.....	536	0	0	0
Scott.....	30,268	19	667	22
Sherburne.....	60,023	7	99	2
Sibley.....	16,285	19	854	52
Stearns.....	110,446	30	1,991	18
Steele.....	6,424	14	273	42
Stevens.....	1,161	3	0	0
Swift.....	3,256	1	34	10
Todd.....	133,227	19	732	5
Traverse.....	1,578	0	0	0
Wabasha.....	64,572	15	1,194	18
Waseca.....	10,895	10	353	32
Washington.....	29,142	8	133	5
Watonwan.....	3,603	1	53	15
Wilkins.....	2,730	0	0	0
Winona.....	102,836	29	660	6
Wright.....	54,950	29	1,612	29
Yellow Medicine..	7,854	3	21	3
	2,015,400	766	35,614	18

1/ United States Census of Agriculture, 1945. Volume 1, Part 8 (Pastured and Unpastured Woodland).

2/ Bureau of the Census record for active mills with known idle mills added, 1945.

3/ Average of 1943 and 1944 data collected by Timber Production War Project, and 1945 data from Bureau of the Census.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 318

Costs of Cutting Jack Pine

For logging plans, timber appraisals, and in forest-management work, it is often desirable to know how much time is needed to cut individual trees or for cutting in various stands. The following information collected in studies made in partial cuttings on the Cutfoot Experimental Forest near Deer River, Minnesota, shows the time required for cutting jack pines of various diameters (table 1) and the effect of tree size on the cost of cutting per thousand board feet or per cord (table 2 on back of sheet).

Table 1.--Time required to cut jack pine trees of various diameters

Cutting activity	Tree d.b.h. -- inches										
	5	6	7	8	9	10	11	12	13	14	15
	Time -- in seconds										
Felling.....	65	75	97	125	160	200	245	295	340	390	440
Trimming....	55	70	100	140	200	265	340	410	495	575	650
Bucking.....	85	145	210	295	400	515	630	725	795	840	875
Operational delays 1/..	80	115	145	180	215	245	280	310	345	375	410
Accidental delays 2/..	43	43	43	43	43	43	43	43	43	43	43
Total time..	328	448	595	783	1,018	1,268	1,538	1,783	2,018	2,223	2,418
	Average Number 100-inch Bolts per Tree										
	2.43	3.61	4.15	4.40	5.56	6.27	5.9	6.85	6.12	6.77	5.8
	Basis: Number of Trees										
	4	12	14	18	23	17	18	12	15	8	4

1/ Includes time for walking between trees, preparation for felling (planning direction for felling trees, cleaning brush away from base of tree, etc.), time between operations of felling, trimming, and bucking, and moving tools.

2/ Includes time for breakdowns, such as hanging of tree, pinching saw, breakage of equipment, etc.

(Over)

Zigmond A. Zasada, Forest Economist
Paul Zehngraff, Silviculturist

July 1949

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Table 2.--Man hours required to cut jack pine trees into 100-inch bolts, in thousand board feet or cords, by tree diameter classes

D.b.h.	Cutting time per tree		Volume per tree		Man hours for cutting	
	4-inch top	6-inch top	Cords	Board feet 1/	Per cord	Per M bd.ft. 1/
Inches	Seconds					
5	328	...	.030	...	3.04	....
6	448	...	.043	...	2.89	....
7	595	449	.060	8	2.75	15.59
8	783	697	.085	18	2.57	10.76
9	1,018	918	.115	35	2.46	7.29
10	1,268	1,186	.150	52	2.35	6.34
11	1,538	1,480	.190	73	2.25	5.63
12	1,783	1,699	.240	99	2.16	4.77
13	2,018	1,925	.280	113	2.00	4.73
14	2,223	2,140	.320	138	1.93	4.31
15	2,418	2,385	.360	159	1.87	4.17

1/ Scribner scale.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Technical Note No. 319

Correction of Soil Acidity in Conifer Nurseries

Repeated use of sulphuric acid and peat in some of the older Lake States conifer nurseries has caused excessive soil acidity. The acid is used to reduce damping-off disease, and the peat to supply organic matter needed on the sandy nursery soils.

Excessive acidity usually becomes evident after July 1 on 2-0 red and 1-0 jack pine as a bright yellow-gold color of the outer half to one-fourth of the needle tips. In extreme cases, height growth is reduced by one-fourth or more. Yellowing shows up strongly in beds where soil pH is around 4.0 to 4.3. It usually disappears where the pH is above 5.0. Optimum growth of these species usually occurs at a pH of about 5.3 to 5.6.

That excessive soil acidity can be corrected was shown by tests made in July 1948 in a northern Wisconsin nursery. Finely-ground limestone was raked into the soil between the drills on an area of fall-sown first-year jack pine in which a third or more of the trees were badly off color. The soil was a fine sand with about 10 percent of silt plus clay. Within 10 weeks after treatment considerable correction of the condition had occurred even in the lightest treatment as shown in the table below:

Ground limestone applied per acre	Trees yellow due to excessive soil acidity		Increase or decrease in yellow trees	Soil acidity in top 4 inches on 9-28-48	Total fresh weight of 100 trees
	7-27-48	10-6-48			
Pounds	Percent	Percent	Percent	pH	Ounces
0	32.6	56.2	+23.6	4.11	8.00
500	39.8	29.0	-10.8	4.60	9.50
1,000	42.4	19.3	-23.1	5.03	10.10
1,500	42.9	17.4	-25.5	5.25	11.20
2,000	34.4	12.6	-21.8	5.51	8.85

Where ground limestone was worked into the soil just before seeding, the tree stand was reduced 20 percent by damping-off. A safer treatment would be to apply limestone to areas on which cover crops, such as legumes or transplants, were to be grown for several years. Limestone should be applied to seedlings only after the stems are past the soft succulent stage, that is after seedlings are at least 10 weeks old. In larger-scale treatment of seedbeds, the material could be worked into the soil with weeding or cultivating equipment.

Based on tests to date, 500 to 1,500 pounds of ground limestone per acre is a conservative treatment, using the lighter amount where minor adjustment of pH is necessary, and the heavier amount for the more acid areas. Treatment with limestone may create a temporary shortage of available nitrogen and may require application of a liquid nitrogen fertilizer to the trees.

July 1949 J. H. Stoeckeler, Forester

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Technical Note No. 320

Near Record Cut of Pulpwood in Lake States--1948

Lake States pulpwood production was at a near record high during 1948, according to recent Station findings. A summary of reports from all pulp mills operating in the region shows that 1948 pulpwood production amounted to approximately 2,184,000 standard cords (rough wood basis) compared with 2,250,000 cords in 1946, the largest volume ever attained in the Lake States. Production in 1948 was approximately 8 percent above that of 1947. The increase was largest in Minnesota with 16 percent. It was 7 percent in Michigan. In Wisconsin, on the other hand, pulpwood production decreased about 5 percent over the previous year.

Aspen, balsam fir, and spruce accounted for most of the increase in production. For the third consecutive year, aspen continued to be the principal pulpwood species of the region. Tamarack, hemlock, and pine production declined 62 percent, 8 percent, and 3 percent respectively below that of 1947.

Compared to a year ago, pulpwood produced in the region and shipped to the other parts of the United States dropped from 47,000 to 29,000 cords. Imports from Canada and the western states were about 16 percent more than in 1947, totaling about 796,000 cords, or about 27 percent of total received.

Production and Imports of Pulpwood - Lake States - 1948

Species and destination	Production by states				Imports			Total Receipts
	Minnesota	Wisconsin	Michigan	Region	Other U.S. 1/	Canada	Total imports	
	Standard cords (unpeeled)							
Aspen								
To Minnesota	248,949	.....	.....	248,949	.....	14,777	14,777	263,726
Wisconsin	27,009	167,054	120,019	314,082	.....	18,460	18,460	332,542
Michigan	.....	.....	46,906	46,906	.....	30,800	30,800	77,706
Exported 2/	.....	.....	14,801	14,801	.....	.....	.....	.....
Total	275,958	167,054	181,726	624,738	.....	64,037	64,037	673,974
Balsam fir								
To Minnesota	75,537	.....	.....	75,537	.....	1,459	1,459	76,996
Wisconsin	73,291	87,352	109,039	269,682	24	9,087	9,111	278,793
Michigan	.....	.....	54,152	54,152	.....	21,711	21,711	75,863
Exported 2/	1,408	.....	.....	1,408	.....	.....	.....	.....
Total	150,236	87,352	163,191	400,779	24	32,257	32,281	431,652
Birch								
To Minnesota	.....	.....	.....	.....	.....	.....	.....	.....
Wisconsin	1,477	7,883	6,821	16,181	.....	303	303	16,484
Michigan	.....	.....	.....	.....	.....	.....	.....	.....
Total	1,477	7,883	6,821	16,181	.....	303	303	16,484

(over)

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Species and destination	Production by states: Minnesota	Wisconsin	Michigan	Region	Imports: Other U.S. 1/	Canada	Total imports	Total receipt
	Standard cords (Unpeeled)							
Hemlock								
To Minnesota	.....	.....	.....	.....	.....	.....	.....	.....
Wisconsin	.....	50,507	85,921	136,428	25	.....	25	136,453
Michigan	.....	.....	45,525	45,525	.....	.....	.....	45,525
Total	.....	50,507	131,446	181,953	25	.....	25	181,978
Pine								
To Minnesota	143,003	92	.....	143,095	.....	43,546	43,546	186,641
Wisconsin	121,874	117,182	24,300	263,356	28,305	15,115	43,420	306,776
Michigan	21,526	.....	64,581	86,107	1,039	44,819	45,858	131,965
Total	286,403	117,274	88,881	492,558	29,344	103,480	132,824	625,382
Spruce								
To Minnesota	143,443	.....	.....	143,443	.....	51,165	51,165	194,608
Wisconsin	113,335	34,162	94,508	242,005	6,145	415,226	421,371	663,376
Michigan	.....	.....	38,986	38,986	.....	93,562	93,562	132,548
Exported 2/	12,476	.....	.....	12,476	.....	.....	.....	.....
Total	269,254	34,162	133,494	436,910	6,145	559,953	566,098	990,532
Tamarack								
To Minnesota	3,456	.....	.....	3,456	.....	60	60	3,516
Wisconsin	1,422	2,650	1,067	5,139	.....	.....	.....	5,139
Michigan	.....	.....	1,168	1,168	.....	.....	.....	1,168
Total	4,878	2,650	2,235	9,763	.....	60	60	9,823
Misc. Hardwoods								
To Minnesota	11	.....	.....	11	.....	.....	.....	11
Wisconsin	.....	81	37	118	.....	.....	.....	118
Michigan	.....	.....	19,328	19,328	.....	.....	.....	19,328
Total	11	81	19,365	19,457	.....	.....	.....	19,457
Waste (slabs, veneer cores, etc.)								
To Minnesota	.....	.....	.....	.....	.....	.....	.....	.....
Wisconsin	.....	1,394	.....	1,394	.....	.....	.....	1,394
Michigan	.....	.....	624	624	.....	.....	.....	624
Total	.....	1,394	624	2,018	.....	.....	.....	2,018
All species								
To Minnesota	614,399	92	.....	614,491	.....	111,007	111,007	725,498
Wisconsin	338,408	468,265	441,712	1,248,385	34,499	458,191	492,690	1,741,075
Michigan	21,526	.....	271,270	292,796	1,039	190,892	191,931	484,727
Exported 2/	13,884	.....	14,801	28,685	.....	.....	.....	.....
Total	988,217	468,357	727,783	2,184,357	35,538	760,090	795,628	2,951,300

1/ Montana, Colorado, South Dakota, Oregon.
2/ Pulpwood produced in the region and shipped to other parts of the United States.

July 1949

A. G. Horn, Forest Economist

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Technical Note No. 321

Sphagnum Moss Retards Black Spruce Regeneration

That sphagnum moss may smother out a high proportion of young black spruce seedlings is illustrated by a study on a clear-cut black spruce swamp on the Superior National Forest, begun in the summer of 1947. Fifty staked seed spots were examined in July, August, and October 1947, and in July and September 1948. Although initial germination was quite high, stocking was cut in half during the first year as a result of smothering by the faster growing sphagnum moss, as shown in the table below. Growth of the surviving seedlings has been excellent despite the average density of nine per spot.

Per Acre Survival in Black Spruce Seed Spots -- Superior National Forest

Date observed	Total		Free from moss		In danger of smothering		Under moss	
	Stocking 1/	Seedlings	Stocking 1/	Seedlings	Stocking 1/	Seedlings	Stocking 1/	Seedlings
	Percent	Number	Percent	Number	Percent	Number	Percent	Number
July 18, 1947	92	7,865	92	7,865	(2/)	(2/)	(2/)	(2/)
Aug. 12, 1947	94	23,982	94	23,982	(2/)	(2/)	(2/)	(2/)
Oct. 14, 1947	94	20,231	30	10,278	46	8,688	18	1,265
July 27, 1948	52	5,518	50	5,252	2	266	0	0
Sept. 28, 1948	50	5,530	50	4,308	0	1,222	0	0

1/ A seed spot containing at least one live seedling was considered stocked.
2/ Not counted.

Loss from smothering by sphagnum probably could be reduced a little by sowing the black spruce seed earlier--in late fall or early spring--to produce larger seedlings by the time the moss begins active growth. However, to make seedings (natural or artificial) in clear-cut black spruce-sphagnum swamps uniformly successful, some practical means must be discovered for killing or retarding the growth of the sphagnum moss and other swamp vegetation. There are indications that some type of chemical spray may fill this need.

October 1949

E. I. Roe, Research Forester

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Technical Note No. 322

Cost of Skidding Jack Pine

The effect of log size and skidding distance on the cost of this operation is illustrated by a time study made on the Cutfoot Experimental Forest near Deer River, Minnesota. Skidding was done by a teamster working alone and using a single horse. Tongs and chains were used for hooking logs. The study covered 258 trips made by two men. Total time of skidding was 13.79 man-hours. The 321 pieces skidded scaled 6,255 board feet, or 14.73 cords. The average volume per trip was 24 board feet, or 1.2 logs.

Total Skidding Time Per Thousand Board Feet or Per Cord of 100-Inch Jack Pine Bolts, by Log Diameter Class and Distance

Log diameter class	Volume skidded per trip		Time required with skidding distances of --						Trips	
			100 feet		200 feet		300 feet		Per M bd.ft.	Per cord
			Per M bd.ft.	Per cord	Per M bd.ft.	Per cord	Per M bd.ft.	Per cord		
Inches	Bd.ft.	Cords	Man-hours						Number	
6	16	.0545	2.68	0.78	4.17	1.22	4.77	1.40	62.5	18.3
8	17	.0545	2.53	0.78	3.92	1.22	4.50	1.40	58.8	18.3
10	36	.0688	1.20	0.62	1.85	0.97	2.12	1.10	27.7	14.5
12	42	.0812	1.02	0.53	1.58	0.82	1.82	0.93	23.8	12.3
14	60	.100	0.72	0.43	1.10	0.67	1.27	0.77	16.6	10.0

Zigmond A. Zasada, Forest Economist
Paul Zehngraff, Research Forester

October 1949

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Technical Note No. 323

Recovery of Winter Injured Pines

It is generally known that the winter of 1947-48 brought about extensive injury to conifers in the northern Lake States. Not so well known, and of more direct importance, is the degree to which injured trees recovered. Information on recovery was obtained for experimental red and Scotch pine plantations (19-year-old from seed) on the Superior National Forest in late summer of 1948. Results for both species have been combined (in the table below) since recovery was quite similar for the same degree of injury.

Degree of Recovery According to Severity of Foliage Injury During 1947-48 Winter--Pine Plantations on Superior National Forest

Amount of foliage injured	Degree of recovery 1/					No injury	Total	Basis trees	Proportion of total
	None	Poor	Fair	Good	Excellent				
Percent	In percent							Number	Percent
0	..	..	..	..	..	100.0	100	962	33.6
1-10	..	..	..	.1	99.9	..	100	766	26.7
11-25	..	..	..	3.5	96.5	..	100	358	12.5
26-50	..	..	6.8	24.8	68.4	..	100	161	5.6
51-75	..	2.4	29.4	43.6	24.6	..	100	126	4.4
76-90	.4	70.8	21.5	6.2	1.1	..	100	274	9.6
91-100	.9	86.7	11.5	.9	..	..	100	218	7.6
Total	.1	13.5	4.6	4.4	43.8	33.6	100	2,865	100.0

1/ Based on proportion of crown with new growth, as follows: None, 0; poor, less than 1/4; fair, 1/4-1/2; good 1/2-3/4; and excellent, more than 3/4.

Readily apparent is the fact that pines with one-fourth or less of their foliage injured showed excellent recovery, and that most of those with less than half their foliage injured recovered satisfactorily. On the other hand, most of the pines with three-fourths or more foliage injury recovered unsatisfactorily.

October 1949

Paul O. Rudolf, Forester

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
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Technical Note No. 324

Basal Area in Merchantable Trees as an Expression of Stocking in Northern Hardwoods

Basal area, the cross-sectional area in square feet of trees at breast height, is becoming more and more popular with foresters as an expression of stocking. Its chief advantage over merchantable volume is its independence of site and defect.

For example, twenty years' selective cutting in old-growth northern hardwood stands on the Upper Peninsula Experimental Forest in Michigan has demonstrated the promise of good board-foot growth where a residual stocking of about 64 square feet of basal area per acre in trees 10 inches and up in d.b.h. is left following cutting. However, the merchantable board-foot volume equivalent to 64 square feet of basal area can vary greatly with different conditions of site and percent of defect as illustrated in the table below:

Board-Foot Stocking Per Acre Equivalent to 64 Square Feet of Basal Area in Trees 10 inches D.B.H. and Up

Cull percent in residual stand	Average merchantable length of residual stand		
	1 log	2 logs	3 logs
Percent	Thousand board feet 1/		
10	4.5	6.9	9.2
15	4.2	6.5	8.6
20	4.0	6.1	8.1
25	3.7	5.7	7.6
30	3.5	5.3	7.1

1/ Scribner.

In the table the basal area of 64 square feet per acre remains constant, yet merchantable volume ranges all the way from 3,500 board feet to 9,200 board feet. This is a point to keep in mind when applying stocking recommendations in board feet to managed stands. At the Upper Peninsula Experimental Forest the board-foot equivalent of 64 square feet of basal area in stands tested is about 6,000 board feet, with a cull percent of 20 and 2-log average merchantable length. But to retain 6,000 board feet indiscriminately as the residual stand following cutting on all northern-hardwood sites is no assurance that optimum growing stock is being maintained.

October 1949

W. M. Zillgitt, Research Forester

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
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Technical Note No. 325

Home-treated Fence Posts Serve Well

Farmers unable to obtain fence posts of durable species at reasonable prices can get reasonably good substitutes by treating aspen, elm, or soft maple posts with zinc chloride, according to observations recently made in Michigan. 1/

In 1938 Frank Vescelius of Livingston County, Michigan, obtained some locally cut fence posts. In cooperation with the Soil Conservation Service he treated 131 (52 quaking aspen, 72 soft maple, and 7 American elm) of these green, unpeeled posts for 12 hours, by the Standard tire-tube method. 2/ Material used per post was one pound of granulated zinc chloride (which cost about eight cents) to one gallon of water. The posts were set in the ground partly on a well-drained upland and partly in a swamp. Five strands of barbed wire were attached with staples.

In 1944, six years after installation, all the posts were reported to be sound and in good condition. In 1949, 11 years after the posts were installed, the fence line was re-examined by representatives of the Lake States Forest Experiment Station and the Soil Conservation Service, and the service condition of the posts found to be as follows:

Site and species	Total posts	Condition of posts				Staple holding properties		
		Still serviceable		Need replacement		Staples used	Staples missing after 11 years	
	No.	No.	Pct.	No.	Pct.	No.	No.	Pct.
Well-drained upland								
Quaking aspen	49	37	76	12	24	245	53	22
Soft maple	54	50	93	4	7	270	58	22
American elm	7	7	100	0	0	35	5	14
Poorly drained site								
Quaking aspen	3	3	100	0	0	15	1	7
Soft maple	18	18	100	0	0	90	5	6

Both service life and staple holding ability of the posts were greater in the poorly drained swamp than in the well drained upland site. Some top rot was observed in 8 aspen posts; however, only 2 were decayed badly enough in the top to necessitate replacement. This top rot may have been due to spotty distribution of zinc chloride. The total number of elm posts and the aspen on the poorly drained swamp site were too few to obtain conclusive service test results.

1/ See also Technical Note No. 246, 1946, LSFES.
2/ Tire-tube Method of Fence Post Treatment, Forest Products Laboratory Report R-1158, revised February 1945.

Wallace R. H. Gunderson, Agr. Aide, LSFES
A. F. Monroe, Forestry Specialist, SCS

October 1949

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 326

Porcupine Damage in a Northern Hardwood-hemlock Forest of Northeastern Wisconsin

When there are four or more porcupines per forty acres they may do serious damage to valuable timber in the northern hardwood-hemlock forests of the Lake States. Damage is caused chiefly by their feeding on the cambium of trees. This brings about partial or complete girdling which may result in breakage, lower quality of timber, less merchantable height, and sometimes death.

These findings were brought out by a damage survey made in April 1949 on 24 fifth-acre plots in a typical second-growth hardwood-hemlock stand containing about 4.0 M board feet per acre on the Argonne Experimental Forest in northern Wisconsin. The stand averaged 183 trees per acre, 5 inches and over, with the following percentage composition: sugar maple, 56.0; hemlock, 13.7; yellow birch, 9.9; ironwood, 4.7; basswood, 4.4; balsam fir 4.2; white ash 2.5; white cedar 1.5; red maple, 1.3; black cherry, 0.8; paper birch, 0.7; and elm, 0.3. All trees over 5 inches were closely examined for porcupine damage and classified as to loss of potential quality by log grades, growth, and relative economic damage. Allowance was made for normal mortality and the porcupine damage figures adjusted downward accordingly.

The survey showed that 9.1 percent of all trees had severe damage and 9.2 percent had slight damage. In extreme cases, 50 percent of all trees were injured. The porcupines preferred vigorous healthy trees, usually of 8- to 14-inch diameter at breast height. They caused an estimated loss of 5.2 percent of the annual board-foot growth and an 8.3-percent reduction in stumpage increase. This is a loss of 9.4 board feet, or 20.8 cents per acre per year, often the equivalent of the annual taxes.

The percent of trees by species, showing severe damage was as follows: basswood, 17; sugar maple, 12; yellow birch, 11; and hemlock, 2. The following species showed no severe porcupine damage: American elm, white ash, red maple, paper birch, black cherry, balsam fir, ironwood, and northern white-cedar. Thus, the three species of highest economic value had the most severe damage. Hemlock rated high in food preference, but this occurred mostly as foliage browsing -- which does not cause an appreciable economic loss, although it may result in reduced growth or death if repeated several times.

Intensive hunting in this tract resulted in a kill of 1 porcupine per 6.67 acres. Many areas of this type of forest are known to have similar or higher porcupine populations. Reduction of their numbers in organized hunts by sportsmen and by individual landowners, hunters, loggers, and foresters would appear well justified.

J. H. STOECKELER, Forester

January 1950

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 327

Growth of Unmanaged Oak-hickory Stands in Southern Michigan

Well-stocked, but unmanaged oak-hickory wood lots in southern Michigan are growing at a rate above 3 percent annually, according to measurements made in 1949 by the Lower Peninsula Forest Research Center in cooperation with the Soil Conservation Service.

In 1939 the Soil Conservation Service established 1/4-acre permanent growth plots in 4 well-stocked farm woods on medium or better oak sites (site indexes 55 to 60 at 50 years). All of the farm woods except one were grazed previous to the time the growth plots were established. However, during the past 10 years, livestock and fire have been excluded and the wood lots have remained relatively undisturbed.

Although the 4 tracts appeared similar in productivity, differences in stand structure, age, and condition of the growing stock have resulted in variable board-foot growth for both the trees of sawlog size (10 inches d.b.h. and larger) in 1939 and the ingrowth (trees reaching sawlog size during the past 10 years). (See tables 1, 2, and 3 on back of sheet).

Annual growth per acre of the sawlog-size trees during the 10-year period averaged from 113 board feet to 221 board feet. Ingrowth for the individual wood lots averaged from 15 to 50 board feet per acre annually for the period. (See table 2 on back of sheet).

Total net growth for the 4 tracts averaged 205 board feet per acre per year during the 10-year period. Since ingrowth can vary greatly in unmanaged oak-hickory wood lots, depending on age and stand structure at the time of study, a more consistent and conservative evaluation of growth can be made from the existing sawlog portion of the stand. For example, net volume of the trees of sawlog size in 1939 in the 4 wood lots averaged 5,313 board feet per acre. The net volume of these same trees less mortality, in 1949, was 7,021 board feet. This is an average increase of 171 board feet per acre per year. It is reasonable, therefore, to expect that under similar conditions sawlog-size trees with a volume of about 5,000 board feet per acre will grow at an annual rate of about 170 board feet per acre, or 3.4 percent per year.

JOHN L. AREND, Research Forester, LSFES
WALLACE R. H. GUNDERSON, Agr. Aide, LSFES
A. F. MONROE, Forestry Specialist, SCS

January 1950
Revised May 1956

Table 1.--Composite stand and stock table per acre of four 1/4-acre growth plots

DBH	1939				1949			
	Trees	Basal area	Cubic vol. 1/	Bd. ft. vol. 2/	Trees	Basal area	Cubic vol. 1/	Bd. ft. vol. 2/
Inches	No.	Sq.ft.	Cu.ft.	Bd.ft.	No.	Sq.ft.	Cu.ft.	Bd.ft.
2	18	.4	4	-	49	1.1	12	-
3	14	.7	8	-	28	1.4	24	-
4	14	1.2	18	-	14	1.2	19	-
5	25	3.4	53	-	15	2.0	36	-
6	19	3.7	71	-	18	3.5	62	-
7	23	6.1	127	-	16	4.3	87	-
8	24	8.4	166	-	11	3.8	88	-
9	15	6.6	160	-	17	7.5	168	-
10	18	9.8	244	410	14	7.6	187	308
11	9	5.9	147	384	13	8.6	228	346
12	10	7.9	196	663	10	7.9	210	627
13	5	4.6	116	418	12	11.1	298	1,224
14	2	2.1	47	220	6	6.4	162	739
15	2	2.5	69	335	3	3.7	91	332
16	6	8.4	253	1,178	1	1.4	35	214
17	0	0	0	0	4	6.3	189	860
18	2	3.5	100	445	3	5.3	166	778
19	1	2.0	68	321	1	2.0	51	194
20	0	0	0	0	2	4.4	140	708
21	0	0	0	0	0	0	0	0
22	1	2.6	86	216	0	0	0	0
23	1	2.9	98	469	1	2.9	95	238
24	0	0	0	0	1	3.1	106	516
25	1	3.4	100	254	0	0	0	0
26	0	0	0	0	1	3.7	112	274
Total	210	86.1	2,131	5,313	240	99.2	2,566	7,358

Table 2.--Volume in board feet by woodlot and growth per acre

Woodlot	Average age 1949	Estimated net vol. 2/ 1939	Estimated net vol. 2/ 1949	Average annual growth: Ingrowth	Average annual growth: Sawlog trees 1939	Average annual growth: Total
	Years	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.
Robinson	70	4,432	6,268	23	161	184
Kerber	80	4,636	7,020	49	189	238
Salmon	70	4,576	7,256	47	221	268
Miller	85	7,608	8,888	15	113	128
Average	76	5,313	7,358	34	171	205

Table 3.--Composition of the four woodlots

Species	Proportion in - 1939	Proportion in - 1949	Proportion in - Change	Species	Proportion in - 1939	Proportion in - 1949	Proportion in - Change
	Pct.	Pct.	Pct.		Pct.	Pct.	Pct.
White oak	31	23	-8	Hickory	13	9	-4
Red oak	7	6	-1	Red maple	18	19	+1
Black oak	20	15	-5	Others (ash elm, cherry etc.)	11	28	+17

1/ Total volume of stem, less bark, based on USDA Tech. Bul. No. 560.
2/ Estimated net volume, International 1/4-inch log rule. Form Class 79.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 328

Is Fire Prevention Effective?

Efforts to educate the public to be careful with fire in the woods seem to be paying off, according to a study recently made by the Lake States Forest Experiment Station.

Fire records were obtained from all the national forests in the Lake States for the period 1936 through 1948. The number of fires which occurred each year was compared with the number to be expected[1/] under the prevailing weather conditions (figure 1 on back of sheet). During the first part of this period the actual number of fires was greater than the expected number. Since 1942, there has been a trend towards fewer fires than were to be expected. This was true even in 1947 and 1948 when adverse weather favored more numerous fires. Although the improvement from year to year has been variable, the trend toward more effective fire prevention is clear (figure 2 on back of sheet). Since most forest fires in the Lake States are man-caused, there is an indication that people are becoming more careful with fire in the woods.

1/ The expected number of fires was determined in this way: (1) The number of fires per day was tallied for each of seven burning index classes which rate the severity of burning conditions, and smoothed averages for each class for the 13-year period were obtained. (2) The number of days in each burning index class for each year was multiplied by the number of fires for that class as determined in step one. (3) The sum of these values for all classes gave the expected number of fires for each year.

January 1950

JOHN S. CROSBY, Forester

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Figure 1.--Actual and expected number of fires per year
(Lake States National Forests)

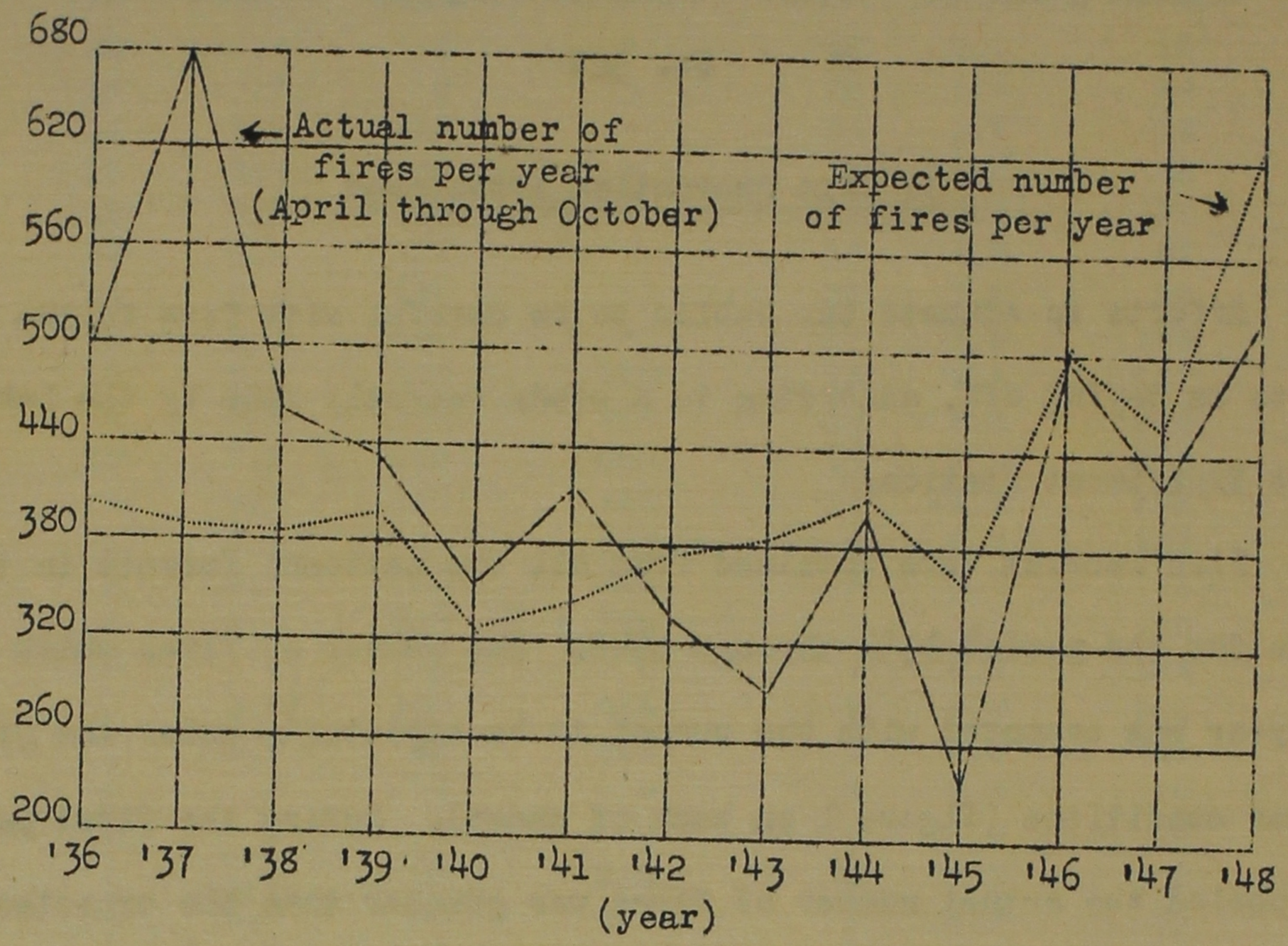
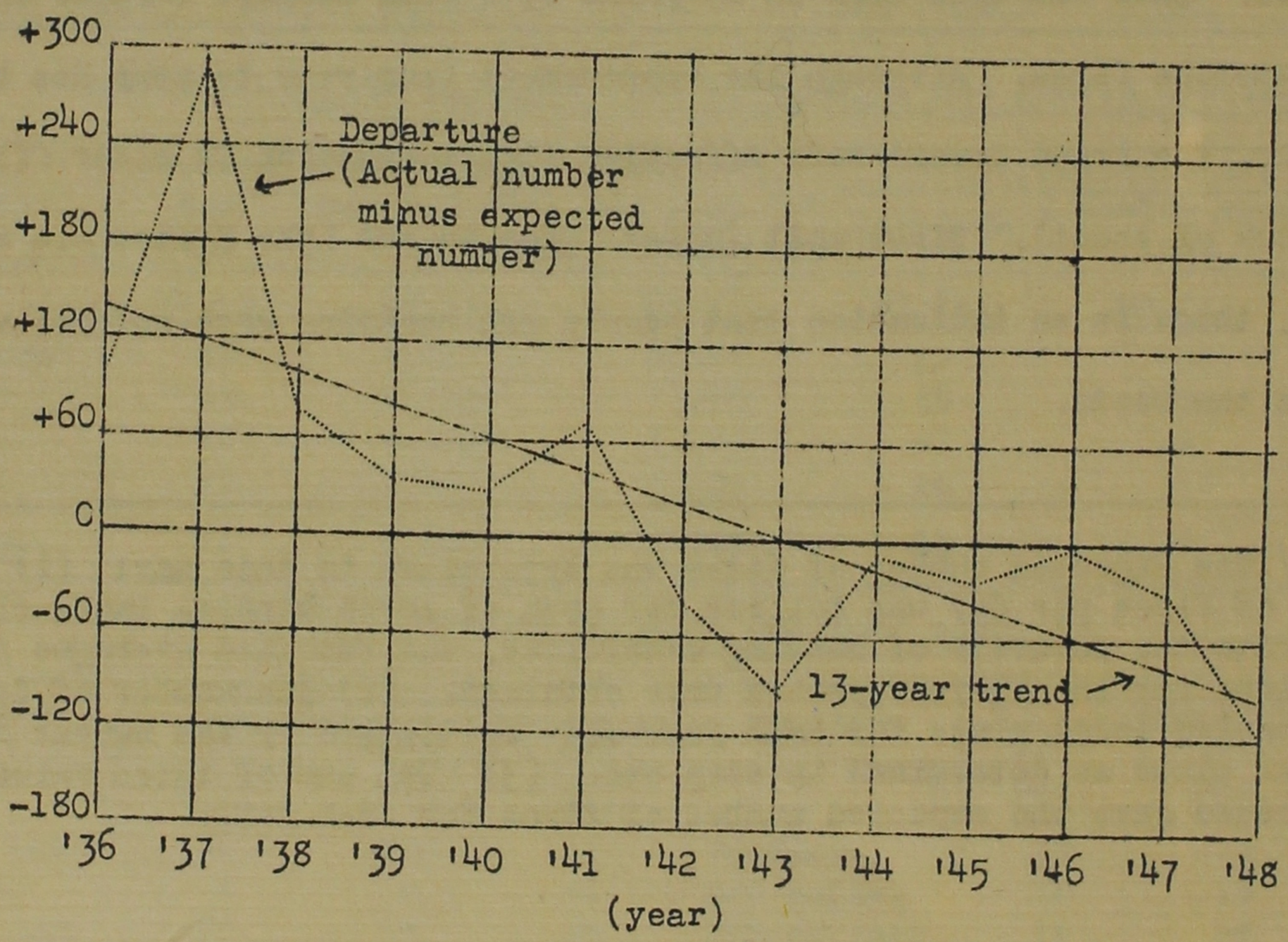


Figure 2.--Departures -- actual from expected number of fires



TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
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No. 329

Converting International 1/4-inch Gross Sawlog Scale to Peeled Total Volume in Cubic Feet

36		221	197	176	164
38				178	165
40				180	166

1/ Total peeled volume - sawlogs and top (no branches) to 4 inches d.i.b.

2/ Sawlogs also include additional volume from an 8-inch to a 6-inch top d.i.b.

3/ Tallied merchantable height above stump to a variable top diameter not less than 8 inches d.i.b.

January 1950

S. R. GEVORKIANTZ, Forester

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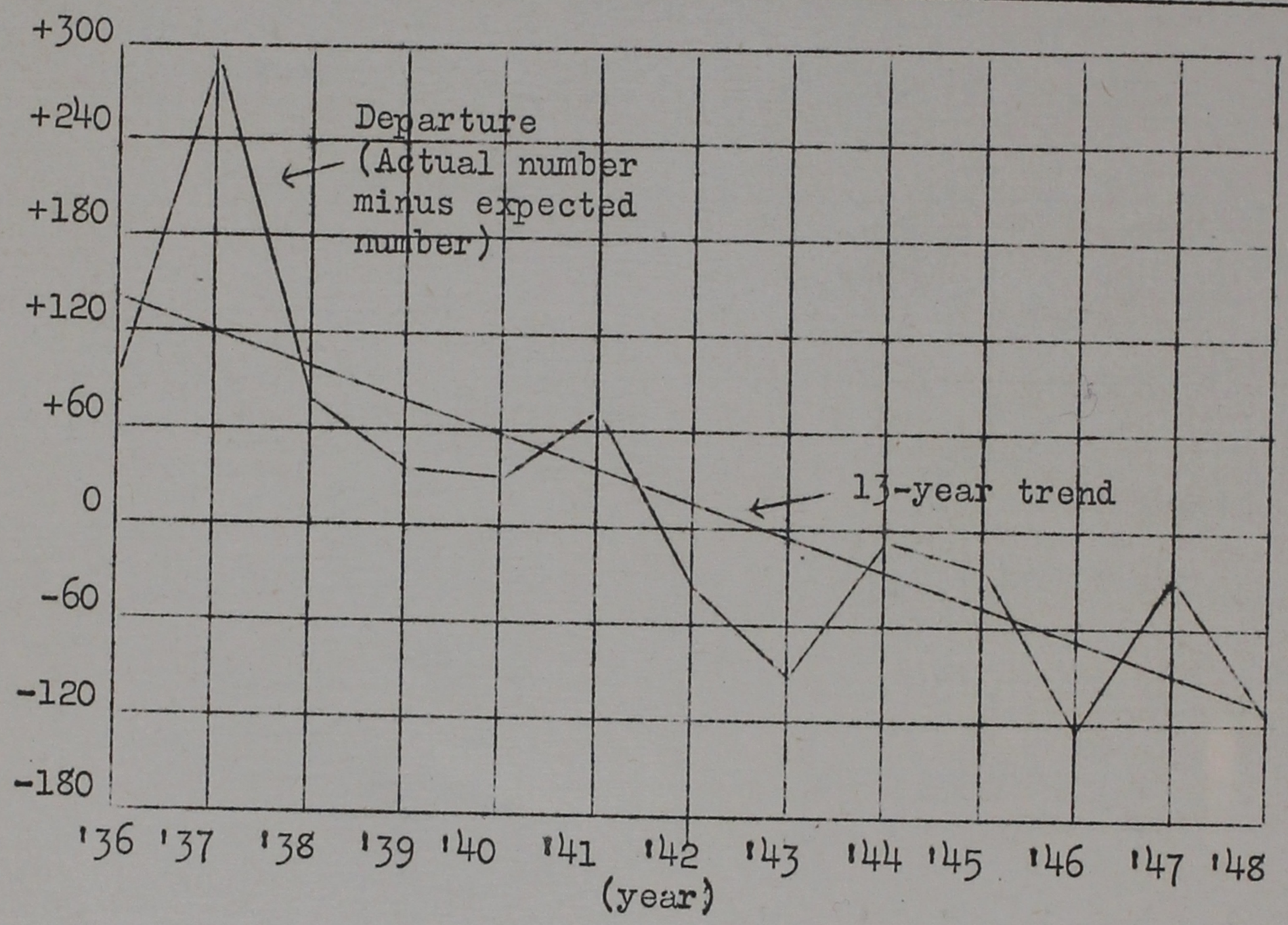
Figure 2.- Departures -- actual from expected number of fires



TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 329

Converting International 1/4-inch Gross Sawlog Scale to Peeled Total Volume in Cubic Feet

Frequently it is necessary to convert wood volumes from one kind of measure to another. One such conversion, used in the Lake States, is given in the table below:

Total peeled volume[1] in cubic feet per 1,000 board feet gross International 1/4-inch scale of sawlogs[2]

(Conifers)

Diameter breast high	Number of 16-foot logs per tree[3]					
	1	1½	2	2½	3	4
Inches	Cu.ft.	Cu.ft.	Cu.ft.	Cu.ft.	Cu.ft.	Cu.ft.
10	211	210	200			
12	209	197	190	185		
14	216	199	185	169	158	
16	229	203	185	170	158	
18	263	217	190	169	159	157
20	294	230	194	175	160	156
22	315	244	199	178	163	155
24	320	252	201	180	166	157
26	324	257	203	183	170	160
28	328	264	207	186	173	163
30	330	270	210	188	173	164
32		274	213	191	174	164
34		277	216	193	175	164
36			221	197	176	164
38					178	165
40					180	166

1/ Total peeled volume - sawlogs and top (no branches) to 4 inches d.i.b.

2/ Sawlogs also include additional volume from an 8-inch to a 6-inch top d.i.b.

3/ Tallied merchantable height above stump to a variable top diameter not less than 8 inches d.i.b.

January 1950

S. R. GEVORKIANTZ, Forester

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 330

Monetary Yields from a Managed Pine Forest

A managed pine forest in northern Minnesota can yield average annual earnings per acre of $3 to $4 as stumpage or $9 to $10 as logs and bolts. This is shown by a recent reinventory of the Cutfoot Experimental Forest in northern Minnesota which represents conditions on the better stocked pine forests in the State. On 2,346 acres of management area there was an average stocking per acre of 1,904 cubic feet, or 5,655 board feet plus 6.4 cords. The annual growth on the entire tract was found to be 551 M board feet (Scribner on trees 7.6 inches d.b.h. and larger) plus 364 cords (to a 3-inch minimum top). This was equivalent to 235 board feet plus 0.16 cord per acre.

Monetary value of this growth at the current average rates is shown below:

Annual growth values

Annual net growth per acre	As stumpage		As logs and bolts	
	Unit values	Value per acre	Unit values	Value per acre
	Dollars			
235 board feet	15.00	3.53	32.00	7.52
0.16 cord	1.50	.23	14.00	2.17
Average annual earnings per acre = $3.76				9.69

The above growth figure on sawlog material is based on sawlog prices and does not take into consideration the fact that some of the volume, due to management, is rapidly developing into considerably more valuable products such as poles and piling.

January 1950

PAUL ZEHNGRAFF, Silviculturist

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 331

Employment Possibilities of a Northern Michigan Forest

The employment possibilities of a given tract of forest land are an important and intriguing aspect of forest management. Several years ago, growth on the Upper Peninsula Experimental Forest at Dukes, Michigan was estimated to be 85 board feet per acre per year for the 4,700 acres then in government ownership. Well stocked and poorly stocked old- and second-growth northern hardwood stands, coniferous and hardwood swamps, and unproductive open lands were included in this acreage. The above growth provides an annual cut under sustained yield of 400,000 board feet of sawlogs or 1,000,000 board feet of all products (pulpwood, posts, and chemical wood included) converted to board feet.

Cutting at the permanent rate of 1,000,000 board feet (converted total) will provide 2,250 days of woods work per year1/ or 3 months' work for 32 forest residents, according to experience records on the Experimental Forest. If 200 days of work a year constitute full-time employment for a worker in forest industries, the 2,250 man days referred to above will provide 11 such full-time jobs. This means, furthermore, that each 425 acres of forest can support one woods worker. In addition, Upper Michigan conversion plants using the 1,000,000 board feet will provide about 3,000 days of work per year or enough to support 15 full-time workers.

If the average growth can be increased even 25 percent under good management to 105-110 board feet per acre, and this is certainly a modest assumption, the annual cut will increase to 500,000 board feet of sawlogs or 1,250,000 board feet of all products. This will provide 2,810 days of woods work per year, or 3 months' work for 40 forest residents. Upper Michigan conversion plants using this material will provide about 3,800 days work more or enough to support 19 full-time workers.

Transportation of this volume to conversion plants will, it is estimated, provide full-year employment to 3 workers on the 1,000,000 board feet basis or 4 workers on the 1,250,000 board feet basis. The income paid all these workers will in turn bolster sales of goods and services by trade and professional men in the area.

This is but one illustration drawn from the management records of a 4,700-acre forest. The 50,000,000 acres of commercial forest land in the Lake States, if managed wisely, can provide many such units of employment.

1/ The large volume of chemical wood removed in logging operations on the Experimental Forest, including wood cut from tree tops, involves considerable hand work and adds materially to the man days of work provided.

April 1950

W. M. Zillgitt, Research Forester

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 332

Damage to Natural Reproduction by Deer Browsing

A large portion of the Argonne Experimental Forest in Forest County, Wisconsin lies within an area that had been closed to all deer hunting for more than twenty years. During this time, the deer herd increased to a very high level and the supporting capacity of the winter yards was reduced seriously by over-browsing. As a result the deer tended to remain on the highland areas in the hemlock and hardwood forest types until late in the winter. During the open winters of 1948 and 1949, there was no noticeable decrease in the number of deer feeding on the upland areas at any time.

Observations of the extent of deer browsing on natural reproduction in swamp and upland forest types were made during the fall and winter months between December 1947 and May 1949. These observations consisted of examination of 606 one-fifth acre plots on the upland and 42 one-fifth acre plots in swamp types. The plots were mechanically spaced over an area of 1,880 acres to eliminate bias in their selection. The amount of deer browse on tree species as compared to the total amount of such browse available formed the basis of the estimate.

The table below shows that 96.4 percent of the plots are in the "Heavy" and "Very Heavy" browse damage classes, a condition which is silviculturally undesirable.

Browse damage class 1/	Forest type											
	Northern hardwood		Hemlock		Other upland		Total upland		Swamp		Grand total	
	Plots		Plots		Plots		Plots		Plots		Plots	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
Light	11	2.3	-	-	-	-	11	1.8	-	-	11	1.7
Medium	9	1.9	-	-	-	-	9	1.5	3	7.1	12	1.9
Heavy	45	9.4	11	10.5	2	9.5	58	9.6	10	23.8	68	10.5
Very heavy	415	86.4	94	89.5	19	90.5	528	87.1	29	69.1	557	85.9
Total	480	100	105	100	21	100	606	100	42	100	648	100

1/ Definition of browse damage classes (based on percent of the available trees showing evidence of browsing by deer on their terminal leader):. Light - less than 10 percent; Medium - from 10 to 50 percent; Heavy from 50 to 80 percent; Very Heavy - more than 80 percent.

Carl Arbogast, Jr., Research Forester
Miron L. Heinselman, Research Forester

April 1950

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 333

1949 A Poor Tree Seed Year in the Lake States

The natural regeneration of forest stands depends primarily upon an adequate seed supply. Suitable seedbeds, favorable weather, control of destructive rodents and birds, while important, are effective only if there is enough seed of good quality. For this reason, annual records of seed crop production are of value to forest managers.

Seed crop estimates from five field branches of the Lake States Forest Experiment Station (table 1 on back of sheet) indicate that 1949 was a poor tree seed year over most of the northern Lake States. In northern Minnesota, all species reported had poor or failed crops except black spruce (medium), jack pine (medium in places), yellow birch (good), and quaking aspen (good). In northeastern Wisconsin, all seed crops failed or were poor except for white ash and black ash (both good). All species reported for central Upper Michigan had failures or poor seed crops. The same was true in Lower Michigan, except for jack pine and eastern white pine which had medium crops.

Southern Wisconsin provided the one exception to the general trend. Eastern white pine and Norway spruce (plantations) had poor seed crops. Basswood, white ash, and white oak had medium crops. Sugar maple, black oak, bur oak, shagbark hickory, black walnut, and butternut had good seed crops, and slippery elm, rock elm, northern red oak, and northern pin oak had bumper seed crops.

It is evident that except in southern Wisconsin little natural tree regeneration can be expected from the 1949 seed crop in the Lake States.

April 1950

Paul O. Rudolf, Forester

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Table 1.- Forest tree seed crop reports in the Lake States -- 1949

Species	Estimated percentage of a full crop[1] in -				
	Northern Minnesota	Northeastern Wisconsin	Southern Wisconsin	Central Upper Michigan	Lower Peninsula Michigan
	Percent	Percent	Percent	Percent	Percent
Red pine	25	7	(2/)-	-	25
Eastern white pine	7	25	20	7	50
Jack pine	25-50	7	-	-	50
White spruce	7-25	7	-	7	-
Black spruce	50	7	-	7	-
Norway spruce	-	7	20	-	-
Balsam fir	7	7	-	7	-
Eastern hemlock	-	25	-	25	-
Northern white-cedar	7	7	-	7	-
Tamarack	7	7	-	-	-
Sugar maple	-	7	85	7	-
Red maple	-	-	-	25	-
American beech	-	-	-	7	-
Basswood	-	7	60	-	-
Yellow birch	80	7	-	25	-
Paper birch	25	7	-	-	-
Quaking aspen	80	-	-	-	-
American elm	-	7	-	7	-
Slippery elm	-	-	95	-	-
Rock elm	-	-	95	-	-
White ash	-	80	55	25	-
Black ash	-	80	-	7	-
Northern red oak	-	25	95	25	7
Northern pin oak	-	-	95	-	7
Black oak	-	-	65	-	7
White oak	-	-	50	-	7-25
Bur oak	-	-	70	-	-
Black cherry	-	7	-	-	-
Shagbark hickory	-	-	85	-	-
Black walnut	-	-	80	-	-
Butternut	-	-	65	-	-

1/ Failure - 0-15 percent of a full crop.
Poor - 16-35 " " " " "
Medium - 36-60 " " " " "
Good - 61-90 " " " " "
Bumper - 91-100 " " " " "

2/ -Signifies no report on this species.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 334

Red Pine Seedling Survival Under Different Levels of Stocking

That the chances for survival of natural red pine seedlings are much better under a light to moderate overstory than under full stocking was brought out by a study carried out on the Cutfoot Experimental Forest in northern Minnesota.

Four different levels of stocking (50, 80, 120, and 160 square feet basal area per acre) were established on adjacent one-half acre plots in 85-year-old red pine during the winter of 1944-45 following an abundant seed crop the previous year. The number of seedlings per acre was determined after logging in the early spring of 1945 and again in the summer of 1949. Seed crops were light during this intervening period.

The following table indicates the number of seedlings established under the different levels of stocking:

Main stand basal area per acre	Number of red pine seedlings per acre 1/			
	Immediately after logging 1945		5 growing seasons later 1949	
	Seedlings	Quadrats stocked	Seedlings	Quadrats stocked
Sq.ft.	Number	Percent	Number	Percent
50	2,250	70	9,400	85
80	3,150	85	4,350	80
120	4,900	100	2,700	85
160 2/	3,500	85	100	10

1/ Based on 20 milacre quadrats per one-half acre plot.
2/ Check plot - uncut.

These data show that the best seedling survival occurred under the lightest overstory, and that even though thousands of seedlings germinated, relatively few survived after five growing seasons under the heaviest stocking.

April 1950

R. A. Ralston, Forester

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TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 335

Log Grade Recovery On A Selection Cutting in Northern Hardwoods of Upper Michigan

What kind of log grades can be expected in a selection cutting of northern hardwoods? An answer to this question was obtained for one stand and one type of cutting in a test carried out on the Upper Peninsula Experimental Forest in 1949. Grades were determined for about 3,000 logs in accordance with log grades of the Forest Products Laboratory (Bul. D1737). 1/

About 3,850 board feet, net, per acre were cut on a 68-acre tract that averaged slightly over 10,000 board feet, net, per acre, Scribner Rule. This stand of old-growth hardwoods was largely overmature and contained between 30 and 35 percent cull, despite the removal in 1941 of approximately 1,200 board feet per acre in an improvement cutting. Slightly under 40 percent of the total volume was removed, totaling 262,850 board feet, net. Basal area in trees 10 inches d.b.h. and up was reduced to 80 square feet per acre. Logs averaged 11 per thousand board feet. All logs not less than 8 inches d.i.b., 8 feet long, and 50 percent sound were considered merchantable. The proportion of different grades is shown below:

Species	Log grade 1		Log grade 2		Log grade 3		Total by species	
	M bd.ft. 1/	Percent 2/	M bd.ft. 1/	Percent 2/	M bd.ft. 1/	Percent 2/	M bd.ft. 1/	Percent 2/
Sugar maple	41.00	15.6	123.50	47.0	70.11	26.7	234.61	89.3
Yellow birch	7.47	2.8	5.87	2.2	3.45	1.3	16.79	6.3
American elm	6.07	2.3	3.79	1.5	.33	.1	10.19	3.9
Red maple	0	-	1.02	.4	.24	.1	1.26	.5
Total	54.54	20.7	134.18	51.1	74.13	28.2	262.85	100.0

1/ Net volume Scribner Dec. C. Log Rule.
2/ Percent of total volume cut.

Some 21 percent of all merchantable logs were of grade 1 quality, compared to 51 percent in grade 2 and 28 percent in grade 3. Yellow birch and elm cut out more grade 1 than grade 2 logs. A policy of leaving low-quality birch for seed trees and the unusually large diameters of the elms largely accounts for this inconsistency. Elm also tends to be either mostly cull and not merchantable or of superior quality.

1/ Logs were graded by W. A. Salminen, Forestry Aid (Research), assisted by the author.

April 1950

F. R. Longwood, Research Forester

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION

U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE

UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 336

Pulpwood Harvest Declines to Prewar Level in Lake States -- 1949

A canvass of all pulp mills drawing wood from the Lake States shows that the 1949 pulpwood cut in this region was approximately 1,550,000 cords. Of this, nearly 30,000 cords were shipped to mills operating outside of the region. Lake States mills obtained an additional 580,000 cords from Canada and the western states, so their total wood receipts were about 2,100,000 cords.

The local cut in 1949 was about one-half million cords short of the 2,100,000 cord yearly average maintained over the 1944-48 period -- a decrease of 26 percent. The most striking decline was in Minnesota and Michigan, where production dropped 39 and 29 percent respectively. The decline in Wisconsin was less than 10 percent.

All species, with the exception of miscellaneous hardwoods showed a decrease from the previous year. Percentage-wise, tamarack, pine, hemlock, and spruce showed the greatest decline.

Imports from Canada were about 30 percent less than in 1948; pulpwood shipments from the western states, on the other hand, were up 57 percent. Spruce made up the largest share of wood obtained from Canada, while most of the western wood was lodgepole pine.

Production and Imports of Pulpwood, Lake States -- 1949

Species and destination	Production by states				Imports			Total receipts
	Minn.	Wis.	Mich.	Region	U.S.1/	Canada	Total	
	Standard cords (rough wood basis)							
Aspen								
To Minnesota	120,919	3,624	.....	124,543	.....	19,273	19,273	143,816
Wisconsin	12,341	181,026	117,527	310,894	.....	21,618	21,618	332,512
Michigan	.....	.....	21,362	21,362	.....	18,564	18,564	39,926
Exported2/	.....	.....	29,114	29,114	.....	.....	.....	.....
Total	133,260	184,650	168,003	485,913	.....	59,455	59,455	516,254
Balsam fir								
To Minnesota	47,794	.....	.....	47,794	.....	339	339	48,133
Wisconsin	69,336	78,028	93,986	241,350	.....	2,886	2,886	244,236
Michigan	.....	.....	30,269	30,269	1	14,763	14,764	45,033
Total	117,130	78,028	124,255	319,413	1	17,988	17,989	337,402
Birch								
To Minnesota	.....	.....	.....	.....	.....	.....	.....	.....
Wisconsin	288	9,712	4,941	14,941	.....	.....	.....	14,941
Michigan	.....	.....	226	226	.....	.....	.....	226
Total	288	9,712	5,167	15,167	.....	.....	.....	15,167

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Damage to Understory Caused by Felling of 17 Dominant Culls in Second-growth Hardwoods

D.B.H. group	Basis, trees damaged	Average No. of damaged trees per cull felled	Total basal area of damaged trees	Basal area of damaged trees per cull felled
	No.	No.	Square feet	Square feet
Damage class 1				
10"+	1	.06	.660	.039
5-9"	5	.29	.991	.058
1-4"	19	1.12	.748	.044
Total	25	1.47	2.399	.141
Damage class 2				
10"+	12	.71	9.587	.564
5-9"	25	1.47	6.513	.383
1-4"	24	1.41	.972	.057
Total	61	3.59	17.072	1.004
Damage classes 1 & 2				
10"+	13	.76	10.247	.603
5-9"	30	1.76	7.504	.441
1-4"	43	2.53	1.720	.101
Total	86	5.05	19.471	1.145

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 337

How Much Does Felling Large Cull Trees Damage the Understory?

What should be done about the large cull trees, remnants of the original stand, that occur in second-growth northern hardwoods? They obviously hinder growth of young trees beneath them. One way of getting rid of them is to fell them, but this causes damage. What the damage amounts to was determined during an improvement cut in second-growth northern hardwoods on the Argonne Experimental Forest.

Detailed records were taken of the effects of felling 17 cull trees averaging 25 inches in diameter at breast height, 67 feet in height, 27 feet in crown diameter, and 36 feet in crown length. Cutting was done with a power saw by a 2-man crew, using all reasonable care to avoid damage. All the trees within the impact area of the crown of each cull were tallied by 1-inch diameter classes. The injured trees were separated into two damage classes as follows:

Damage Class 1 - Trees damaged beyond recovery.

Damage Class 2 - Trees damaged but expected to live for at least another decade.

For each cull felled, 1½ trees were damaged beyond recovery (see table on reverse side), and another 3½ trees were damaged less severely. Some damage was done to about half the trees in the impact zone of the crowns of felled trees. Considering only the understory trees 5 inches d.b.h. and larger, each cull felled damaged 2½ trees or 1.044 square feet of basal area.

If this figure is applied to the entire stand on which an average of 4.8 culls per acre were felled, about 12 trees or 5.011 square feet of basal area per acre would be damaged. This amounts to 6.6 percent of the stems or 6.0 percent of the total basal area of growing stock 5 inches and over.

Since the loss is among trees badly needed for future growth, it appears that other methods of cull removal such as girdling or poisoning should be considered because they damage the understory less.

CARL ARBOGAST, JR., Research Forester

July 1950

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Damage to Understory Caused by Felling of 17 Dominant Culls in Second-growth Hardwoods

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 338

Lake States Pulpwood Cruisers Table

To obtain a rapid, reliable estimate of pulpwood volumes (especially in even-aged stands where average stand diameter can be estimated closely), proceed as follows:

1. Count pulpwood trees (5.0 inches d.b.h. and larger) on a 1/10-acre plot. (Radius 37.2 feet; side of square = 1 chain.)

2. Estimate the diameter range of the trees counted[1/] or the average main stand diameter to the nearest 1/2 inch.

3. Estimate the average number of 8-foot bolts per tree to the nearest 1/4 bolt. Multiply by the number of trees counted to get the total number of bolts.

4. Look up -- in the table below -- volume in cords per acre corresponding to the diameter range, or average d.b.h., and number of bolts estimated.

Middle range in d.b.h.	Average d.b.h.	Total number of 8-foot bolts per 1/10 acre									
		5	10	20	30	40	60	80	100	150	200
Inches	Inches	Cords per acre (to 4-inch top d.i.b.)									
5-7	6	.8	1.5	3.0	4.5	6.0	9.0	12.0	15	22	30
5-9 small	6½	.9	1.7	3.4	5.1	6.8	10.2	13.6	17	26	34
5-9	7	1.0	1.9	3.8	5.7	7.6	11.4	15.2	19	28	38
5-9 large	7½	1.1	2.1	4.2	6.3	8.4	12.6	16.8	21	32	42
7-9	8	1.2	2.3	4.6	6.9	9.2	13.8	18.4	23	34	46
7-11 small	8½	1.3	2.5	5.0	7.5	10.0	15.0	20.0	25	38	50
7-11	9	1.4	2.8	5.6	8.4	11.2	16.8	22.4	28	42	56
7-11 large	9½	1.6	3.1	6.2	9.3	12.4	18.6	24.8	31	46	62
9-11	10	1.7	3.3	6.6	9.9	13.2	19.8	26.4	33	50	66
9-13	11	2.0	3.9	7.8	11.7	15.6	23.4	31.2	39	58	78
11-13	12	2.3	4.5	9.0	13.5	18.0	27.0	36.0	45	68	90

1/ Excluding occasional trees outside the major range of diameter classes present.

July 1950

S. R. GEVORKIANTZ and P. C. GUILKEY, Foresters

MAINTAINED BY THE U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 339

Can Nurserymen Produce White Pine Seedling Stock Comparable to Transplants?

By growing 3-0 white pine seedlings at a nursery density of about 25 per square foot, stock comparable to 2-1 transplants can be produced at a lower cost, according to an experiment conducted at Hayward Nursery in Wisconsin.

Trees were grown for three years in nursery beds at six densities ranging from 13 to 81 per square foot. Each density was replicated four times. Samples of the trees were measured, and 100 trees from each of 24 nursery beds were field planted in the fall. A lot of 2-1 white pine was also planted for comparison, thus making a total of 2,800 trees in the field plots. The results in the nursery and in the field are summarized below.

Age class	Density per square foot in seedbed	Average size of trees before planting: Top length	Root length	Stem caliper	Fresh weight	Top-root ratio by weight	Good[1] quality nursery trees produced	First-year field survival
	No.	Inches	Inches	64ths inch	Grams		Percent	Percent
2-1	--	4.3	10.7	7.3	4.2	1.7	98	94
3-0	13	3.4	12.2	8.0	6.7	2.5	96	90
3-0	26	4.1	10.7	7.4	6.2	3.1	89	87
3-0	40	4.4	9.6	6.6	4.2	3.4	76	82
3-0	47	4.9	10.4	6.8	4.8	3.5	72	78
3-0	59	4.5	10.2	6.3	3.7	3.2	72	76
3-0	81	5.0	9.8	6.0	3.5	3.7	62	74

1/ Of stem caliper 6/64 inch and over.

The table shows that in the range tested, the denser the trees were grown, (1) the taller and spindlier they became, (2) the lower their weight and quality were, (3) the higher their top-root ratio[1] became, and (4) the poorer their field survival was. Density classes 13 and 26 had field survivals almost as good as 2-1 transplants.

In spring planting, density of beds and balance of stock is not quite so critical, and first-year survivals of over 90 percent were obtained on favorable sites from 3-0 stock grown as dense as 50 per square foot in the nursery.

1/ This ratio is based on comparison of weight of tops to weight of roots and is a good criterion of the balance of stock. The lower the ratio, the better is stock balance.

JOSEPH H. STOECKELER, Forester

July 1950

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 340

Does the Partial Cutting of Northern Hardwoods Result in Inferior Reproduction?

The quality of reproduction following partial cutting of northern hardwoods compares favorably with that produced after clear cutting. This is true, at least, for 5 cuttings established between 1927 and 1929 on the Upper Peninsula Experimental Forest in Michigan. A summary made in 1948 of all living reproduction of merchantable species ranging from 0.6-inch d.b.h. to 20-30 feet high on randomized strips on 6 cuttings and a reserve area is given below:

Number and proportion of Good Young Trees Per Acre in 1948[1]

Degree of cutting (in percent of gross bd.ft. volume)	Total young trees per acre	Good trees per acre[2]		Proportion of trees with good attributes[3]				
		Number	Proportion	Good origin	Good position	Good form	Good condition	Good clear length
Percent	No.		Percent					
100	1,558	414	27	60	58	81	89	64
90	1,226	420	34	72	55	85	90	69
62	984	394	40	76	59	83	97	63
46	774	414	53	86	73	83	94	62
24	506	310	61	90	89	85	89	55
No cutting (reserve)	640	340	53	96	82	75	85	55
Group cutting	1,130	522	46	87	64	77	94	53

1/ Based on 0.5-acre tally from each cutting.

2/ Good in origin, position, form, and condition. Clear length not considered because of the young age of these trees.

3/ Good origin means seedling or seedling sprout; good position means dominant, codominant, or intermediate; good form means straight to moderately crooked; good condition means vigorous with no rot; and good clear length means free of branches for at least half of length.

The number of all-around good trees per acre falls off some for the lightest cutting, but even here there are sufficient trees for a satisfactory future stand. The proportion of good trees increases regularly from clear cutting through light improvement cutting.

The proportion of good trees when a single attribute only is considered is usually higher than the proportion of all-around good trees for a given cutting. This results from some trees being good in one attribute and poor in another. In origin and position the lighter cuttings excel; in form and condition there is little variation; and in clear length the heavier cuttings are slightly superior.

W. M. ZILLGITT, Research Forester

July 1950

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 341

What Do Fence Posts Cost on An Annual Basis? 1/

Each year Minnesota farmers set more than 10 million new fence posts -- most of them wooden. They choose posts chiefly on the basis of low initial cost and ease of setting. Little consideration is given to their durability.

Yet, probably the soundest basis for determining the cost of fence posts would be the initial cost of the set post, distributed over its serviceable life. By means of the table on the reverse side of this sheet, which gives these annual costs for a wide range of initial cost and durability of posts, fence-post users can determine which of the posts available to them are most economical. A few representative examples are given in the table below:

Representative Annual Costs of Types of Fence Posts in Minnesota

Kind of post	Initial cost of set post	Average service life	Annual cost
	Dollars	Years	Dollars
Hand-set, 7-foot, 3½-inch wooden			
Nondurable species (untreated) 1/	.40 - .60	3	.13 - .20
Moderately durable species (untreated) 2/	.40 - .60	7	.06 - .09
Durable species (untreated) 3/	.40 - .60	12	.03 - .05
Preservative treated	.75 - .90	25	.03 - .04
7-foot steel post (driven)	1.00	20	.05

1/ Aspen, cottonwood, willow, birch, hickory, pine, spruce, etc.
2/ Tamarack, red oak, elm, small-size northern whitecedar.
3/ White oak, large northern whitecedar.

1/ This is a contribution from a broad study of fencing and fence-post problems which is financed in part by Research and Marketing Act funds, and is a joint study being made by the School of Forestry, University of Minnesota in cooperation with the Divisions of Agricultural Engineering and Agricultural Economics, and the Lake States Forest Experiment Station.

J. R. NEETZEL, Forester
Lake States Forest Experiment Station
S. A. ENGENE, Division of Agricultural Economics, University of Minnesota

October 1950

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Annual Cost of Fence Posts, Based Upon Initial Cost of Set Posts and Serviceable Life

Cost of set posts 1/	Annual cost of fence posts when life of posts in years is								
	3 2/	5	7 3/	9	12 4/	16	20	25 5/	30
Dollars	Dollars								
0.40	0.13	0.08	0.06	0.04	0.03	0.02	0.02	0.02	0.01
.50	.17	.10	.07	.06	.04	.03	.02	.02	.02
.60	.20	.12	.09	.07	.05	.04	.03	.02	.02
.70	.23	.14	.10	.08	.06	.04	.04	.03	.02
.80	.27	.16	.11	.09	.07	.05	.04	.03	.03
.90	.30	.18	.13	.10	.08	.06	.04	.04	.03
1.00	.33	.20	.14	.11	.08	.06	.05	.04	.03
1.10	.37	.22	.16	.12	.09	.07	.06	.04	.04
1.20	.40	.24	.17	.13	.10	.08	.06	.05	.04
1.30	.43	.26	.19	.14	.11	.08	.06	.05	.04

1/ To be computed by user, depending upon cost of posts and labor and equipment required for setting.

2/ Average service life of posts cut from nondurable wood (untreated) -- aspen, cottonwood, willow, birch, hickory, maple, pine, spruce, balsam fir.

3/ Average service life of posts cut from moderately durable wood (untreated) -- tamarack, red oak, elm.

4/ Average service life of posts cut from durable wood (untreated) -- northern white-cedar, burr and white oak, eastern redcedar. Also, possibly aspen treated with chromated zinc chloride.

5/ Average service life of posts of any species well treated with creosote or pentachlorophenol. Deep penetration of the preservative is essential.

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 342

Growth in Two Oak Woodlots Following an Improvement Cut

Board-foot growth in some oak woodlots may be increased as much as 20 percent annually for 10 years after improvement cuttings according to measurements made by the Lower Peninsula Forest Research Center and the Soil Conservation Service in southern Michigan.

In 1939, the Soil Conservation Service made light timber-stand improvement cuts for demonstration purposes on one-acre plots in two different oak woodlots in Livingston County, Michigan. These cuttings removed only mature, poorly formed and defective trees for farm use. Six standard cords were removed per acre in one woodlot and 9.3 cords plus 700 board feet of logs per acre in the other. White oak, black oak, hickory, and red maple predominated in both stands. The sites were medium in productivity for oak (site index 60 at 50 years). The soil type in one is Berrien sandy loam and in the other Hillsdale-Bellefontaine sandy loam. Livestock and fire have been excluded during the period of study. One-fourth acre sample plots were laid our to record stand development both in the treated and untreated areas. Plot remeasurements in 1949 indicated the previous decade's development as shown below:

Average stand per acre in 1939 and 1949 and the annual increase

Item	Trees 1.6 inches d.b.h. and larger	Basal area	Volume	
	Number	Sq.ft.	Cu.ft.1/	Bd.ft.2/
Cutover				
1939	184	76	1,897	5,922
1949	434	103	2,440	8,206
Annual increase	25	2.7	54	228
Undisturbed				
1939	238	92	2,293	6,122
1949	332	107	2,737	7,954
Annual increase	9.4	1.5	44	183

1/ Total volume of stem, less bark, based on tables in U.S.D.A. Tech. Bul. 560.

2/ Estimated net volume, International 1/4-inch Rule, form class 79. Of the annual increase in board feet ingrowth makes up 14 percent on the cutover plots and 17 percent on the undisturbed area.

Growth in simple interest based on the annual increase in net board foot volume from 1939 to 1949 with these volumes of growing stock averaged 3.8 percent on the cutover plots compared to 3.0 percent on the undisturbed plots.

This increased growth clearly demonstrates how better management can improve the value of farm woodlots.

JOHN L. AREND, Research Forester, LSFES
A. F. MONROE, Forestry Specialist, SCS

October 1950

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 343

How Long Can Conifers Be Held in Spring by Cold Storage?

In the spring many nurserymen hold planting stock in cold storage to keep it dormant pending shipment or transplanting. The effects of such storage on first-year nursery survival and growth are shown by an experiment conducted at Hugo Sauer Nursery, Rhinelander, Wisconsin, in which jack pine, red pine, white pine, and white spruce trees were lifted on May 3 and stored at 50° F. for 0, 1, 2, 3, 4, and 5 weeks respectively before transplanting on May 3, 10, 17, 24, 31, and June 7. Another test involved lifting and immediately transplanting trees on the dates above mentioned.

First-year survivals were 95 percent or higher for all of the three pine species, whether stored for 1 or 5 weeks. White spruce dropped to 81 percent after 5 weeks storage and had begun to drop off (93 percent) after 4 weeks. All trees of the four species lifted and transplanted the same day, even though in a succulent stage in the late transplantings, survived 95 percent or higher.

Nursery survival, however, does not tell the entire story. Prolonged cold storage reduces vigor and size of plants because they lose some of the best growing weather in late spring and early summer. Such loss in size and its resulting higher cull percent is serious in conifers left in the transplant beds for only one year, when every week of additional growing weather is important. For stock left in transplant beds for two years, it is of less importance. The loss in weight from 5 weeks cold storage ran from 20 to 42 percent (see table below). It was greatest in case of jack pine, which starts growth early in spring.

Species and age when transplanted	Average oven-dry weight per tree-end of season		Loss in weight due to late transplanting	
	No cold storage 1/	5 weeks cold storage 2/	No cold storage 2/	5 weeks cold storage 2/
	Grams	Grams	Percent	Percent
Jack pine (1-0) . . .	4.05	2.36	35	42
Red pine (3-0) . . .	4.12	3.30	18	20
White pine (3-0) . .	4.56	3.67	8	20
White spruce (2-2). .	8.26	5.92	3	28

1/ Transplanted May 3.
2/ Transplanted June 7.

It appears that late transplanting with or without cold storage has an adverse effect on growth, and that it is accentuated by long storage.

October 1950 JOSEPH H. STOECKELER, Forester

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

Technical Note No. 344

Classifying Black Spruce by Tree Vigor and Dominance can Aid the Tree Marker

Classifying black spruce trees as an aid to marking has been advocated on the basis of a small-scale study reported in 1943.1/ Recent analysis of growth records on over 1,100 black spruce greatly strengthens the conclusion that classifying crown vigor and position gives a good indication of growth.

These data were collected in northern Minnesota in connection with a cutting experiment established in 1941 by the Station in cooperation with the Minnesota Forest Service. The original stand varied in age from 50 to 150 years. Most of the larger trees were over 130 years old, although a considerable portion of the medium and small size trees were younger. Volume ranged from 24 to 32 cords per acre, and the site was classified as medium. Two intensities of cutting and an uncut portion of the stand are represented in the data. After cutting, the remaining trees 3.6 inches and larger on 23 tenth-acre plots were classified as to position (dominant, codominant, and intermediate) and vigor (progressive, stable, and regressive).

Average diameter growth during the first five years after cutting (shown graphically on the reverse side of this Note) was greatest within any tree class in the open stand resulting from heavy cutting (to a 2-stick limit). However, the residual stand was greatly understocked and tree mortality has been high. The moderate cutting resulted in a fairly well stocked stand where growth was good and mortality not excessive. Total net growth for the first five years about equaled that of the uncut stand which was much more heavily stocked.

The marked relationship between tree class and growth is apparent in all three stands.

1/ *LeBarron, Russell K. 1942. Partial cutting in black spruce in the Lake States. Papers of the Michigan Academy of Science, Arts and Letters, V 28: 249-260, 1942 (published 1943).*

L. P. NEFF, Forester

[redacted] 1950
October

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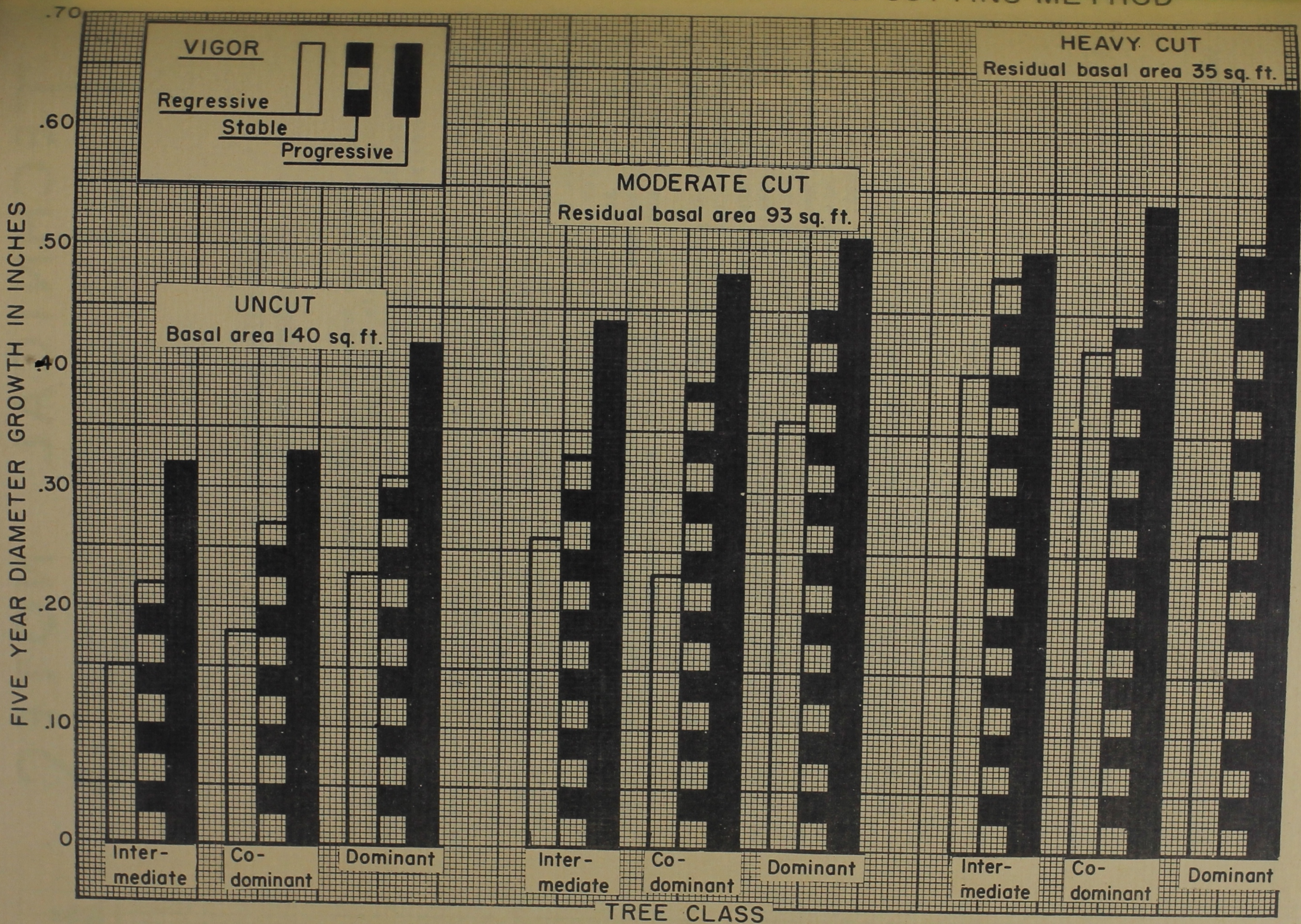

DIAMETER GROWTH BY TREE CLASS AND CUTTING METHOD
VIGOR
Regressive
Stable
Progressive
UNCUT
Basal area 140 sq. ft.
MODERATE CUT
Residual basal area 93 sq. ft.
HEAVY CUT
Residual basal area 35 sq. ft.
FIVE YEAR DIAMETER GROWTH IN INCHES
.70
.60
.50
.40
.30
.20
.10
0
Inter-mediate
Co-dominant
Dominant
Inter-mediate
Co-dominant
Dominant
Inter-mediate
Co-dominant
Dominant
TREE CLASS

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 345

Sawlogs From A Young Pine Plantation

Pine plantations can show a profit at an early age, according to the results of a recent cutting on the Superior National Forest. In the spring of 1948, part of the 33-year-old Birch Lake Plantation was removed in a road-widening job. This plantation, planted to an 8x8 foot spacing, has logs up to 11 inches in diameter at the butt end which were removed and sold. If the Birch Lake Plantation were cut clear today, it would bring a gross return of about $80 per acre on the sawlogs and pulpwood it contains. This would be better than 3½ percent compound interest on the original planting cost, plus charges for plantation care, taxes, land rent, roads, and general administration which a private owner would pay.

Ordinarily, most of the trees in such a plantation would not be cut for many years. However, at the rate this plantation is growing, thinnings will be needed in a year or two to prevent slackening of its growth. Such thinnings will yield pulpwood, mine lagging, and likely a few small cabin logs. Only the poorer trees, such as those poorly-formed and those which have fallen behind in growth, will be cut. The rest will be left for future crops. This illustrates the fact that forest plantations in this region offer good possibilities for timber production and returns can be realized a few decades after planting.

October 1950

E. I. ROE, Research Forester

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 346

Releasing White Pine From Oak and Aspen

Small suppressed white pine released from oak and aspen overstories often become overtopped by sprouts of these species and need to be released again. The success of the operation depends primarily on the height of the pine when released. Since white pine will respond with increased growth after release following long periods of suppression, there usually is no urgency to release it early. The taller the pine is at the time of release, the better is it able to compete with the sprout growth.

From observations made in Lower Michigan, it appears that the white pine must be at least 4 to 5 feet tall and preferably 6 to 8 feet tall before it can successfully compete with hardwood sprouts. The pine usually requires 2 to 3 years after release to respond with improved height growth. During this time the hardwood sprouts can grow from 4 to 6 feet in height. For several years thereafter, height growth of the sprouts usually exceeds that of the pines. Three examples of growth resulting after release are given on the reverse of this sheet.

In Example I the pines were 1 foot high and 4 years old at the time of release. They were soon overtopped by oak sprouts and will very likely have to be released again.

In Example II the pines were 5-1/2 feet high and 19 years old at the time of release. They were overtopped by some of the oak sprouts 12 years later but were still growing well. The sprout growth should slow up somewhat in the future, and some of the pines will compete successfully with the hardwood growth.

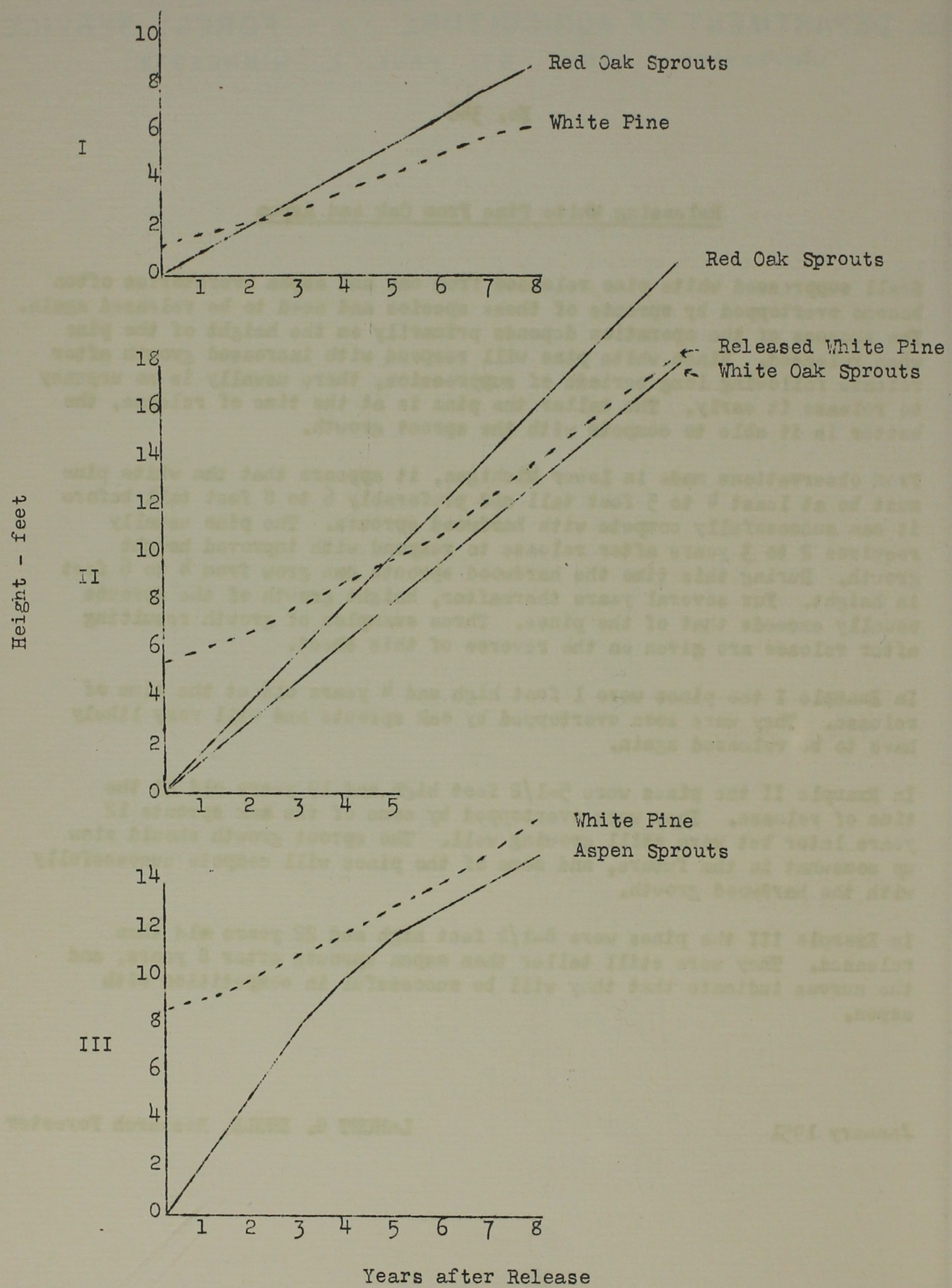
In Example III the pines were 8-1/2 feet high and 22 years old when released. They were still taller than aspen sprouts after 8 years, and the curves indicate that they will be successful in competition with aspen.

January 1951

LaMONT G. ENGLE, Research Forester

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

HEIGHT GROWTH AFTER RELEASE



TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION

U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE

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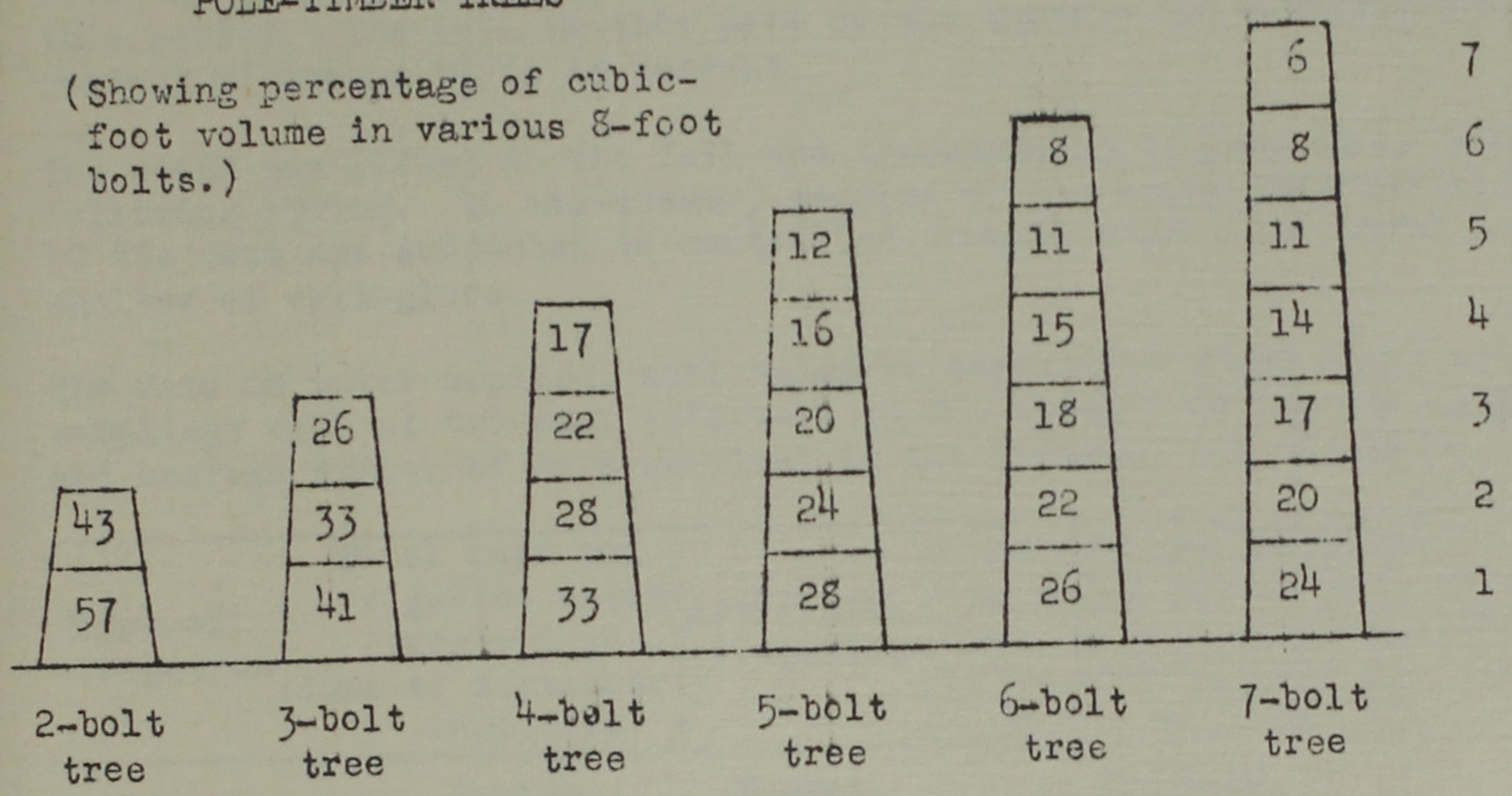
No. 347

Distribution of Volume in Lake States Trees

For estimating cull and for other purposes, foresters often need to know the proportion of total volume in various sections of a tree. The following figures, made for use on the Forest Survey, apply to the average run of commercial trees of all species in the Lake States.

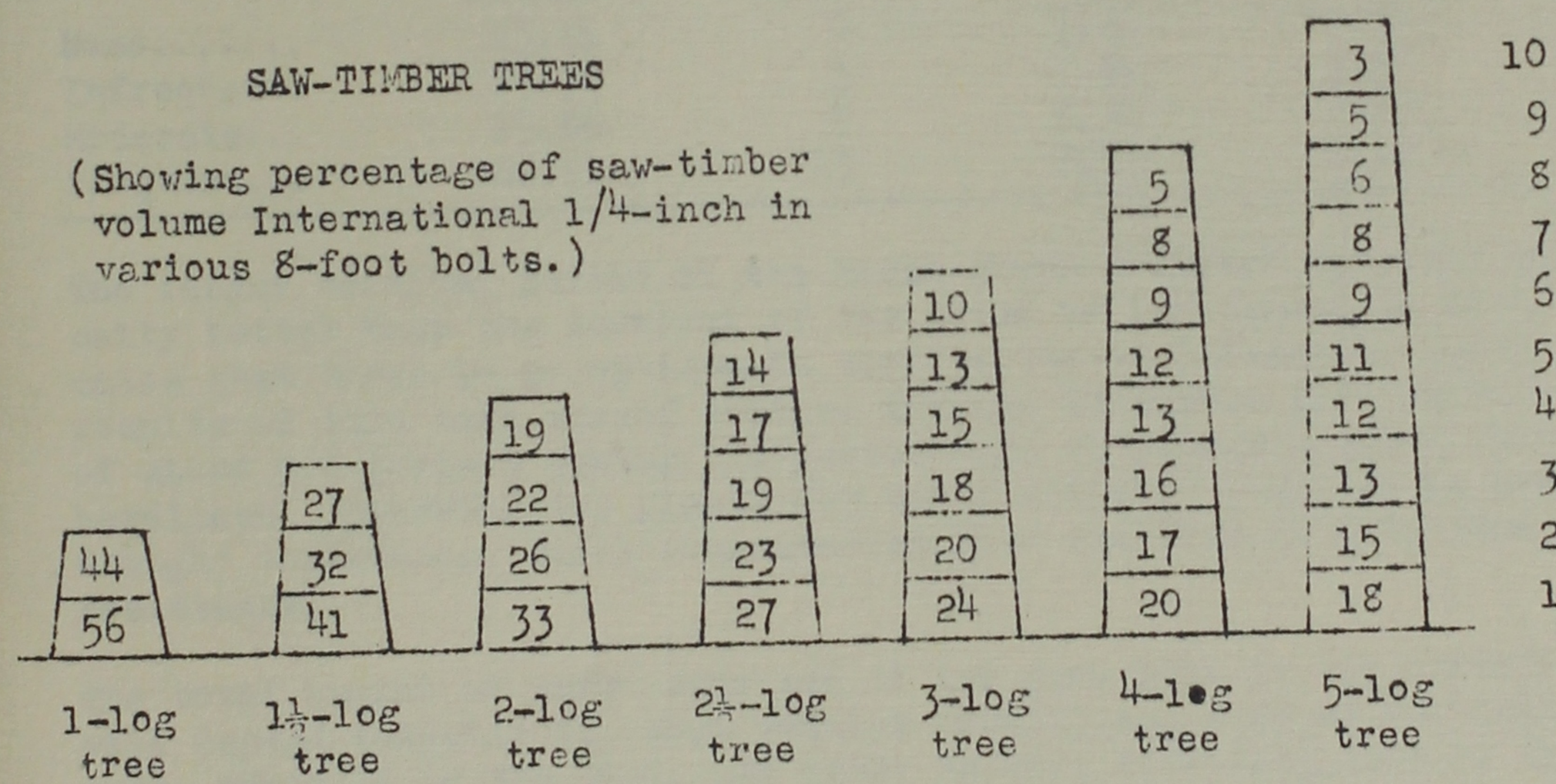
POLE-TIMBER TREES

(Showing percentage of cubic-foot volume in various 8-foot bolts.)



SAW-TIMBER TREES

(Showing percentage of saw-timber volume International 1/4-inch in various 8-foot bolts.)



S. R. GEVORKIANTZ, Forester

January 1951

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 348

Proper Watering in the Nursery Produces Drought-hardy Jack Pine

That proper regulation of watering in the forest nursery improves drought hardiness of nursery stock was demonstrated in a test conducted at the Hayward and Hugo Sauer Nurseries in Wisconsin.

Beds of second-year jack pine at Hayward Nursery were given no, infrequent, moderate, and frequent watering. The irrigation water applied during the four months of June to September inclusive amounted to 0, 2.25, 4.75, and 7.00 inches respectively. All beds received 15.11 inches of rainfall during this period. The soil in this part of the nursery had a silt-plus-clay content of around 10 to 12 percent.

The stock was lifted in the fall and transplanted at Hugo Sauer Nursery the following spring. In mid-summer, samples of the stock were potted in number 10 tin cans and subjected to controlled drought conditions under a rainproof shelter of celloglass.

The data on water applied, soil moisture conditions based on 27 soil samplings made at two-week intervals in the nursery during the watering test, and average number of days survival in the drought test are given below:

Type of irrigation	Total rain and irrigation water received in June to September inclusive	Artificial irrigations	Average soil moisture in top 8 inches from June to Sept. inclusive		Average time surviving in drought test
			Total	Available	
	Inches	Number	Percent		Days
None.....	15.11	0	7.25	3.81	23.6
Infrequent.	17.36	3	7.39	3.95	26.1
Moderate...	19.86	9	8.38	4.94	27.7
Frequent...	22.11	13	9.54	6.10	25.6

The longer survival period of the trees given moderate watering was statistically better than the survival of the trees in the unwatered beds, and indicates that there is an optimum in application of irrigation water. The results of this test showed that an average available soil moisture content of about 5.0 percent during the period June to September gave optimum drought hardiness. Starving the plants for water actually resulted in weakening drought resistance, while overwatering also resulted in some loss of drought resistance.

The total amount of water supplied to 2-0 jack pine in the nursery naturally will depend somewhat on other weather conditions, such as rainfall, temperature, exposure to the wind, and other factors affecting rate of transpiration. It would appear worth while, however, to attempt to maintain the most desirable available soil moisture content.

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

JOSEPH H. STOECKELER, Forester

January 1951

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
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No. 349

Lake States Forest Trees Produce Good Seed Crop in 1950

In contrast to 1949, which was generally a poor seed year in the Lake States, 1950 was quite good. Estimates from five field branches of the Lake States Forest Experiment Station (see table on reverse side) indicate that most species in most localities had good or bumper 1950 seed crops.

In northern Minnesota seed production was not as good in the Koochiching County area as it was further south or east, but over most of the area all species produced good or bumper crops, except jack pine and black spruce (medium), and quaking aspen (poor). Locally, white spruce and quaking aspen crops failed, and northern white-cedar and tamarack were poor.

Northeastern Wisconsin generally had the most favorable conditions. White spruce, black spruce, Norway spruce, balsam fir, northern white-cedar, yellow birch, paper birch, black ash, and black cherry all had bumper crops. All other species had good crops except red pine, sugar maple, and red maple (medium), and northern red oak (poor). In southern Wisconsin, which was the one locality having rather good crops in 1949, all species again were good except Norway spruce, white ash, shagbark hickory, bitternut hickory (medium), and northern red oak and black oak (poor).

In central Upper Michigan good or bumper seed crops were produced by white spruce, black spruce, eastern hemlock, northern white-cedar, American beech, yellow birch, American elm, and black ash. Other species reported had medium crops (eastern white pine, balsam fir, sugar maple, red maple, and northern red oak).

In the Lower Peninsula of Michigan all species had good or bumper crops except northern red oak and white oak in the north half (poor) and red pine (failure). In localities where the 1949 late spring frost was not severe, both red pine and the oaks had good crops, but such localities were not common.

Over most of the Lake States region, therefore, it appears that seed supplies should be sufficient to provide abundant natural reproduction provided germination and growing conditions are suitable. Seed collectors and seed-eating animals as well should have been able to harvest adequate supplies of most species.

January 1951

PAUL O. RUDOLF, Forester

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Annual Cost of Fence Posts, Based Upon Initial Cost of Set Posts and Serviceable Life

Cost of set posts 1/	Annual cost of fence posts when life of posts in years is								
	3 2/	5	7 3/	9	12 4/	16	20	25 5/	30
Dollars	Dollars								
0.40	0.13	0.08	0.06	0.04	0.03	0.02	0.02	0.02	0.01
.50	.17	.10	.07	.06	.04	.03	.02	.02	.02
.60	.20	.12	.09	.07	.05	.04	.03	.02	.02
.70	.23	.14	.10	.08	.06	.04	.04	.03	.02
.80	.27	.16	.11	.09	.07	.05	.04	.03	.03
.90	.30	.18	.13	.10	.08	.06	.04	.04	.03
1.00	.33	.20	.14	.11	.08	.06	.05	.04	.03
1.10	.37	.22	.16	.12	.09	.07	.06	.04	.04
1.20	.40	.24	.17	.13	.10	.08	.06	.05	.04
1.30	.43	.26	.19	.14	.11	.08	.06	.05	.04

1/ To be computed by user, depending upon cost of posts and labor and equipment required for setting.

2/ Average service life of posts cut from nondurable wood (untreated) -- aspen, cottonwood, willow, birch, hickory, maple, pine, spruce, balsam fir.

3/ Average service life of posts cut from moderately durable wood (untreated) -- tamarack, red oak, elm.

4/ Average service life of posts cut from durable wood (untreated) -- northern white-cedar, burr and white oak, eastern redcedar. Also, possibly aspen treated with chromated zinc chloride.

5/ Average service life of posts of any species well treated with creosote or pentachlorophenol. Deep penetration of the preservative is essential.

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
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No. 350

Cost of Setting Fence Posts in Minnesota[1/]

Each year Minnesota farmers set 10 to 12 million posts in repairing and constructing fences. Any practices which will reduce the manpower used will help to make labor available for other necessary tasks.

Records of the labor required for setting fence posts were kept on several fences built in 1949 and 1950 at University of Minnesota branch stations at Waseca and Rosemount, Minnesota. Crews of two or more men were used to set posts approximately 26 inches deep in line fences.

Operation	Number of posts set per man-hour of labor[1/]
Hand digging and setting wooden posts.....	4
Power digging and hand setting wooden posts.....	6
Hand-driving steel posts.....	13
Power driving pointed wooden posts.....	15

1/ Basis, 120 to 290 posts set.

When hand labor alone was used, an average of about four posts were set per man-hour. Power digging was much more rapid than hand digging, but the costly hand tamping required for each post still made for low production. When posts were driven, much less manpower was required.

Hand-driving of steel posts more than doubled the productivity per man. Pointed wooden posts driven by tractor power used even less manpower.

Although these studies do not purport to give complete results for all fencing conditions, they do indicate that power-driven pointed wooden posts are the most economical of manpower. Other studies have shown that wooden posts properly pretreated have a long service life. Therefore, in economy of setting and life in the fence, wooden posts can compare very favorably with steel posts. Wider use of wooden posts not only can improve utilization of small trees, but also can help conserve steel for more vital needs.

J. R. NEETZEL
Forester, Lake States Forest Experiment Station
and
Research Associate, School of Forestry, U. of Minn.

January 1951

1/ This is a contribution from a broad study of fencing and fence post problems being made by the School of Forestry, University of Minnesota, in cooperation with the University's Divisions of Agricultural Engineering and Agricultural Economics, and the Lake States Forest Experiment Station, and is financed in part by Research and Marketing Act funds.

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 351

HEIGHT GROWTH OF THINNED RED PINE

That thinning improves not only diameter growth but also height growth of young red pine is indicated by results of tests made in Lower Michigan. In 1939 the Michigan Department of Conservation thinned two stands on the Houghton Lake and Higgins Lake State Forests. One stand was 43-year-old natural growth and the other a 27-year-old plantation. In 1939 the unthinned portion of the natural stand had 3,668 trees and 168 square feet of basal area per acre while the thinned portion had 1,100 trees and 102 square feet of basal area per acre. There were 1,524 trees and 131 square feet of basal area per acre in the unthinned portion of the plantation and 620 trees and 65 square feet of basal area in the thinned portion. The site for both stands is slightly below medium for red pine.

Height growth of the two stands from 1939 to 1949 is shown in the table below:

Crown class	10-year height growth			
	Plantation		Natural stand	
	Thinned	Unthinned	Thinned	Unthinned
	Feet		Feet	
Dominant and codominant trees	11.6	10.9	11.0	8.9
Intermediate trees	-	9.9	8.7	5.4

The difference in growth between the thinned and unthinned portions of the plantation was not great, probably because competition in the unthinned portion was not too severe. However, in the natural stand the effect of thinning was much more pronounced. This stand was evidently overstocked to such an extent that even height growth on dominant trees was greatly improved by the thinning.

Although these results are limited to two examples, it is evident that dense stand conditions in young red pine are not always necessary for best height growth. In fact, thinnings in young, well-stocked or over-stocked stands can improve height growth.

April 1951

LaMONT G. ENGLE, Research Forester
NORMAN F. SMITH, Michigan Department of Conservation

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
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No. 352

Ingrowth Following Cutting in Northern Hardwoods

Ten old-growth northern hardwood stands were studied on the Upper Peninsula Experimental Forest at Dukes, Michigan to determine the importance after cutting of ingrowth, or the volume of trees that have grown past an adopted lower limit of measurement during a specified period. Eight stands had been partially cut, one was clearcut, and one was an uncut reserve. All merchantable trees (9.6 inches plus) had been measured at five-year intervals over a twenty-year period. The following table shows the average annual gross ingrowth per acre over 5, 10, 15, and 20 year periods:

Kind of cutting	Proportion of gross saw-timber volume removed	Average Acre: Pole-size trees left 1/	Pole trees reaching saw-timber size by various periods: 0-5 years	0-10 years	0-15 years	0-20 years	Average annual ingrowth: Gross volume	Proportion of total growth
	Percent	Number	Number				Bd.ft.	Percent
Clear cutting	100	4.50	0	.5	4.5	10.5	14	58
12" dia. limit	90	13.00	3.5	9.5	18.5	28.5	28	16
70% selection	68	12.75	3.2	7.7	14.2	16.0	34	14
Overmature and defective #1	62	14.00	3.0	6.5	12.0	18.0	34	13
Overmature and defective #2	59	6.00	3.0	6.0	8.0	2/	20	7
Heavy imp.	46	12.00	2.0	5.0	10.5	14.5	29	12
Group selection	45	14.75	1.0	4.8	8.0	12.2	28	13
22" dia. limit	29	17.75	3.0	6.5	11.3	12.0	3/27	12
Light imp.	24	6.00	2.0	5.0	5.0	9.0	17	7
Reserve check	0	17.00	1.0	2.0	4.5	5.5	10	14

1/ Trees 7, 8, and 9-inch d.b.h.
2/ Plot 15 years old.
3/ Average for 17 years.

Board-foot ingrowth on light to moderately heavy cuttings constituted only a minor portion (7-13 percent) of the total annual growth over the twenty-year period. Average annual ingrowth varied from 10 board feet, gross, on the check area to 34 board feet on the 62 and 68 percent cuttings. Ingrowth on light to moderately heavy cuttings varied from 17 to 29 board feet. Clear cutting showed an annual average of only 14 board feet as very few trees had reached board-foot size in the 20 years after cutting.

The small volume of ingrowth is due to the deficiency of pole-size trees in the original stands. However, the rate of ingrowth generally increased throughout the first 20 years following cutting. The relative proportion of ingrowth by species was found to be very similar to the species composition of the original stand, with a slight tendency for sugar maple to increase its proportion on light cuttings and to decrease on heavy cuttings.

F. R. LONGWOOD, Research Forester

April 1951
MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 353

Early Release from Aspen Improves Yield of Pine Plantations

Pine plantations overtopped by aspen will lose much of their potential wood production if they are not released early, according to a study made by the Station in the Birch Lake plantation near Ely, Minnesota.

This 90-acre burn on the Superior National Forest was planted to red pine in 1915 and 1917. But aspen came in, and by 1931 it had overtopped five-sixths of the plantation. A survey at that time showed that one-sixth of the plantation needed no release, a like portion was beyond salvage, and two-thirds consisted mostly of an aspen overstory with pines underneath, many badly suppressed. Sample plots representing two degrees of release and check areas were established. During the following winter (15 to 17 years after planting), part of the area where pines were overtopped was given complete release at a cost of $2.75, or one man-day, per acre. A comparison of the released plots with the untreated check and the portion of the plantation needing no release was made in 1949, 18 years after treatment. This brings out these facts (see table below):

Treatment	Cordwood volume per acre (3 inch top utilization)						Total stumpage value 1/
	1931			1949			
	R.P.	Aspen	Total	R.P.	Aspen	Total	
	Cords			Cords			Dollars
None	1.9	5.9	7.8	16.2	15.6	31.8	40.20
Moderate release	2.2	0.6	2.8	20.2	8.0	28.2	44.20
Full release	1.6	0.1	1.7	23.7	2.2	25.9	48.50
No release needed	1.9	-	1.9	32.9	0.3	33.2	65.95

1/ Based on red pine at $2.00 and aspen at $0.50 per cord.

(1) Even delayed release increased the volume of pine cordwood. (The difference was much less than it would have been if much of the aspen on the check plot had not been killed by a tent caterpillar epidemic.)

(2) The plot needing no release (comparable to a plantation released promptly) had much more red pine cordwood than any of the others despite the fact that it is two years younger. If clear cut today it would yield 25 to 40 percent more cash return than the plots where release was long postponed. The study shows that to obtain the greatest dividends from over-topped plantations, release must be done at an early age.

April 1951

EUGENE I. ROE, Research Forester

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
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No. 354

Reducing Wood Waste in the Lake States

Only 60 percent of the wood harvested in the Lake States actually appears as a merchantable product, according to Forest Service data for 1944. The other 40 percent is wasted during logging or manufacture (see table on back of sheet).

Since wood-using industries are of great importance in the Lake States and must now depend partly on material shipped in from other regions, it is important to reduce wood waste as well as to build up forest production. Both the national and the regional economy demand increased wood production. There will always be some wood wasted between the harvesting of the tree and fabrication of the final wood product, but it can be reduced greatly by measures such as the following:

1. Good logging.- Cut low stumps, use proper trimming allowance, fell trees skillfully to avoid breakage and injury to other trees, choose log lengths carefully for maximum yield of all products.

2. Suitable equipment.- Use improved logging equipment; use portable sawmills and portable chippers where feasible.

3. Integration of pulpwood cuttings with sawlog operations to utilize material often wasted.

4. Improved storage facilities for sawlogs and pulpwood to reduce decay between harvesting and manufacturing.

5. Efficient manufacturing processes, especially in small mills. Increased manufacture of "small dimension stock" from hardwoods and "cut-up stock" from softwoods can yield valuable products from short lengths, slabs, and edgings.

One way to help translate these general suggestions to specific recommendations would be to have a forest utilization service unit of 2 or 3 men attached to the Station. Such units, already established in all other major forest regions of the United States, serve as connecting links between the Forest Products Laboratory at Madison, Wisconsin, and local small wood-using industries and forest land owners. The men of the units are sufficiently familiar with research findings to assist in disseminating such information promptly. At the same time they report current utilization problems to the Laboratory and thus help guide its program realistically. Either directly or in collaboration with technicians from the Laboratory the forest utilization men help to bring about more efficient wood utilization in the regions they serve.

April 1951

E. L. DEMMON, Director

(over)

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Amount of Wood Used and Wasted in Lake States, 1944[1]

Major product logged	Amount harvested[2]	Amount wasted			Amount merchantable material produced	Proportion used of amount harvested
		In logging	In manufacture	Total		
	Million cu.ft.	Million cu.ft.	Million cu.ft.	Million cu.ft.	Million cu.ft.	Percent
Saw timber	333	149	48	197	3/100	30
Pulpwood	179	19	19	38	140	78
Fuel wood	96	9	-	9	4/138	144
Miscellaneous 5/	90	23	13	36	40	44
Total	6/698	200	80	280	418	60

1/ Data on amount harvested from table 26, Reappraisal Report I, "Gaging the Timber Resource of the U.S.;" data on amount wasted from table 5, Reappraisal Report IV, "Wood Waste in the U.S.;" data on merchantable material produced, from files of the Lake States Forest Experiment Station.

2/ Includes material cut from merchantable growing stock 5 inches d.b.h. and over to a 4-inch minimum top diameter, excluding bark.

3/ Some byproducts of saw-timber logging end up as pulpwood, fuel wood, and other products, and are not included in this figure.

4/ Fuel-wood use amounted to 360 million cubic feet, the difference being dead or other material not appearing in amount harvested.

5/ Veneer logs, mine timbers, posts, etc.

6/ Normal annual drain on the forest from other causes include fire, 6 million cubic feet, and insects and diseases 43 million feet, or a grand total drain of 747 million cubic feet for the region.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 355

Deer Damage May be Reduced by Use of Repellents

Deer may cause considerable damage to forest reproduction by browsing in concentration areas or where protected from hunting. Landowners may find it worth while to protect small forest plantations, or ornamentals and natural trees around recreation areas. A recent test gave promise that this can be done by spraying small trees with chemical deer repellents.

In northeastern Wisconsin a one-year-old plantation of 2-1 white pine was sprayed in October 1949 with a commercial repellent containing zinc dimethyl dithiocarbamate cyclohexylamine with polyethylene polysulfide as an adhesive. An examination in May 1950 indicated that the treatment had reduced over-winter damage considerably (see table below). The plantings had been made in the spring of 1949 in an area of moderate to heavy deer concentration. Similar sprayings made on 1,200 jack and red pine had less effect because the deer browsed these species very little, regardless of whether they were treated or not.

Treatment	Number of trees planted	Planted trees thrifty in May 1950	Trees injured over winter by deer
		Percent	Percent
Check, no treatment	200	32.0	49.0
Sprayed with deer repellent	200	63.0	12.5

Such sprayings of susceptible species, using 1 pound of repellent per 2.5 gallons of water, seem to be particularly effective over winter if applied in September. Additional spraying may be needed, however, as soon as the snow goes off in the spring and possibly in late winter if the trees are not covered by snow. In other tests with sprayings made in the spring, damage was negligible by September, indicating that fall spraying was more effective than spring spraying. The spraying required one man-day per acre, treating about 1,000 trees.

J. H. STOECKELER, Forester
M. L. HEINSELMAN, Research Forester

April 1951

AINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 356

Christmas Trees Provide Early Returns From Red Pine Plantations

High net returns through partial cuttings for Christmas trees are being obtained from some plantations on public lands sooner than was anticipated at the time of planting. This is illustrated by a 58-acre red pine plantation on the Lower Michigan National Forest. The plantation was established in the fall of 1941 with 1,200 trees per acre on a good old-field site. Survival was excellent. In the fall of 1950 an average of 89.2 trees per acre was sold for Christmas trees at an average stumpage of $0.54 each. Costs and returns covering the 9-year period from establishment to the time of cutting are given below:

	Total	Per acre
Gross income from stumpage.....	$ 2,796.42	$ 48.21
Cost of sales administration.....	80.00	1.38
Payment to counties in lieu of taxes	699.11	12.05
Net return from sales.....	$ 2,017.31	$ 34.78

This return more than offsets the 1941 cost of planting at $10.55 per acre and 9 years' fire protection cost of $0.90 per acre. The operation still leaves a valuable growing forest which before long will be yielding pulpwood and eventually sawlogs. In addition, the counties received a substantial revenue and local residents obtained seasonal work.

The partial cutting could hardly be classed as a thinning because it was not needed at this particular time. However, the cutting appeared to be good business and the plantation remains practically intact with over 1,000 trees per acre. The trees were cut so as to leave at least one whorl of green branches on each stump. From observations of older cuttings, it appears that these branches will become erect and may produce more Christmas trees or grow to pulpwood size. In this way, the same trees may be the source of two crops.

Not all red pine plantations can be expected to produce Christmas trees from early cuts. Dry sites frequently produce off-color trees and on the best sites the distance between whorls is too great for well-formed trees. However, in many plantations, early selective cuttings for Christmas trees offer promising opportunities for completely liquidating the initial investment without damaging the stand.

JOSEPH R. STEPHENSON, District Ranger
Lower Michigan National Forest
and
LA MONT G. ENGLE
Research Forester

July 1951

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 357

Disking to Increase Stocking in Aspen Stands

There are many acres of poorly stocked aspen stands in the Lake States. Some of these lands are owned by private timber companies which are concerned with the low productivity in their present state. One promising method of increasing stocking in such stands is to stimulate natural regeneration of aspen, and other species to a lesser extent, by disking.

The Northern Paper Mills of Green Bay, Wisconsin, with holdings near Amasa, Michigan, cooperated with the Station in further tests of this method on company lands in May 1950. An Athens type disk, 6 feet wide, and a crawler type tractor were used in the tests. Four understocked aspen areas were strip-disked with strips approximately 8 to 12 feet apart, center to center, at a cost of about $2.50 per acre. Units 1, 2, and 3 in the test are all on loamy sand, but Units 2 and 3 rate as better sites than Unit 1. Unit 4 is very rocky, soddy, and has been heavily grazed.

Results after only one growing season show (see tabulation below) how sprouts (mostly aspen) have increased following disking.

Comparison of Stocking on Disked and Undisked Areas

Unit	Disked 1/			Undisked (check) 2/	
	Area	Stems per acre	Quadrats stocked	Stems per acre	Quadrats stocked
	Acres	Number	Percent	Number	Percent
No. 1	10	6,125	70	1,600	50
No. 2	4	11,100	88	1,400	60
No. 3	6	11,600	90	4,000	80
No. 4	16	3,325	52	1,800	60

1/ 40 milacre quadrats of tally on each disked area.
2/ 10 milacre quadrats of tally adjacent to each disked area.

Units 2 and 3 increased the most with over 11,000 stems per acre and about 90 percent stocking. This might be expected because of better site conditions. Unit 4 is so rocky and was so sparsely stocked originally that heavy root suckering could not be expected.

It is still too early in the experiment to foretell with certainty what the ultimate fate of these new sprouts will be. There are now too many in spots, but they may thin themselves. Subsequent examinations will clear up this point and may disclose some natural seeding in the exposed mineral soil as well. Without question, however, the disking stimulated a great deal of sprouting.

W. M. ZILLGITT, Research Forester

July 1951

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 358

Is Jack Pine Tree Growth Affected by Age of Parent Seed?

Jack pine development as measured in terms of total height and diameter growth is not influenced by the relative age of the parent seed which is sometimes retained on the tree for many years in the persistent unopened cones. This contention is borne out by the results of an experiment established in 1938 on the Cutfoot Experimental Forest in northern Minnesota.

At that time 1,600 jack pine 1-1 transplants in four equal lots from seed formed in 1935, 1934, 1933-32, and prior to 1932 were planted 5 x 5 feet apart in scalps in the form of a latin square of four replications on a site formerly carrying the well-stocked 65-year-old parent stand. The results after 14 years' growth in the nursery and in the field are summarized below:

14 years' growth	Age of seed in years when sown (1935)			
	1	2	3-4	5 and up
Average total height - feet	16.5	16.4	16.3	16.5
Average d.b.h. - inches	2.2	2.3	2.2	2.3

Cone production by this 14-year-old plantation has been quite uniform and has not been affected by the age of the seeds.

In evaluating the results of this study, it should be kept in mind that only successful nursery stock was used in the field. However, most workers agree that, while seed from older cones may have a somewhat lower germinative capacity than that from newer cones, for all practical purposes viability remains high in seed stored on the tree for 5-10 years or longer.

The results of this experiment clearly indicate that once jack pine seedlings become established any apparent differences in their future growth cannot be attributed to the age of the parent seed.

R. A. RALSTON, Forester

July 1951

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 359

Chemical Sprays Reduce Right-of-way Maintenance Costs

The manpower and money required to keep down brush along telephone line right-of-ways can be reduced through the use of chemical sprays according to studies made in 1948 and 1949 on the Nicolet National Forest in northeastern Wisconsin.

During June and July the foliage of new sprouts (averaging 90,000 stems per acre) and 8-year-old growth (averaging 10,000 stems per acre) was sprayed in a 15-foot strip along 1.6 miles of telephone line in the northern hardwood and aspen types. One part by volume of isopropyl ester of 2,4,5-T in 100 parts of water was applied to individual clumps of sprouts with a 5-gallon back-pack fire pump. Ammonium sulfamate at 1 pound per gallon of water gave similar results when applied in the same manner.

Sprouts 3 to 12 months old were reduced 90 percent by one spraying of either chemical. The 8-year-old sprouts, however, required two treatments in successive years to get a moderately good kill. The cost per mile of one spraying was $16.24 as compared to $39.10 for hand cutting.

In other tests, sprays were applied with a Panama fire-fighting pump coupled directly to the motor of a pickup truck and with the operator standing in the back of the vehicle. This method was fast, but wasteful of spray material. The cost per mile was $35.47, of which $30.11 was for chemicals. In the hand spraying, for example, materials cost only $13.91 per mile. Costs of pumper spraying would appear more favorable if used in very dense stands of sprouts and with finer nozzles.

The relative susceptibilities to eradication by the chemicals tested for various tree and shrub species encountered on these trials are given below:

Easy to kill	Moderately resistant	Hard to kill
Hazel	Paper birch	Sugar maple
Sumac	Yellow birch	Red oak
Pin cherry	American elm	White ash
Dwarf willow	Boxelder	Basswood
Alder	Aspen	Blackberry
	Mountain maple	Dogwood
	Gooseberry	
	Elderberry	

J. H. STOECKELER, Forester

July 1951

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 360

Why Release Young Maple from Pin Cherry?

Maple reproduction overtopped by pin cherry will come through satisfactorily without artificial release according to recent remeasurements made by the Station in 36- to 46-year-old stands on the Hiawatha National Forest in the Upper Peninsula of Michigan.

In 1934 six 1/20-acre sample plots were established in a stand consisting of mature pin cherry overtopping apparently suppressed sugar and red maple. The pin cherry was about 30 years old, 30 to 35 feet high, and made up 20 to 25 percent of the stand. The maple was 5 to 10 years younger, about 10 feet shorter, and accounted for 75 to 80 percent of the total number of stems.

On five plots all pin cherries and a few "wolf trees" that overtopped or seriously interfered with the upper half of the maple crowns, an average of 860 trees per acre, were eliminated by cutting or girdling. One plot was left uncut as a check.

That cultural work was unnecessary is indicated by the 1950 stand table (see reverse side). Fourteen years after treatment there were only 3 percent fewer pin cherry trees on the released plots than on the check plot. The untreated plot originally had 30 percent more trees on the average than the treated plots but 16 years later (1950) had nearly 15 percent fewer trees per acre. The difference is largely in the 1- and 2-inch d.b.h. classes. The reduced competition resulting from the partial removal of the overstory on the treated plots apparently prevented the normal death of many seedlings and small trees. It also provided suitable conditions for numerous new seedlings and sprouts to become established. Consequently, the treated plots are now more overcrowded than the untreated plot.

There is no visible difference in height, crown condition, clear length, form, or quality between the treated and untreated stands.

An earlier short-term study in an 11-year-old northern hardwood stand on the Upper Peninsula Experimental Forest was concluded after 5 years with results very comparable to this study.1/ Although neither study showed any justification for artificial release, it is possible that similar cultural practices in older stands may be more beneficial, particularly when the trees are of sufficient size to yield merchantable products.

1/ Lake States Forest Experiment Station, 1940. Do Young Second-growth Hardwoods Need Care? L.S.F.E.S. Technical Note No. 167.

July 1951
Rev. August 1951

F. R. LONGWOOD, Research Forester

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Comparison of Young Maple Stands with and without Release from Overtopping Pin Cherry

D.B.H. class (Inches)	Trees per acre							
	1934				1950			
	Treated 1/		Not treated 2/		Treated 1/		Not treated 2/	
	Pin cherry	All species	Pin cherry	All species	Pin cherry	All species	Pin cherry	All species
	Number				Number			
1	228	2,768	340	2,920	4	1,312	--	860
2	196	704	340	1,180	24	664	--	440
3	24	168	340	540	56	292	40	440
4	--	96	160	200	36	164	100	160
5	--	28	40	100	12	80	40	160
6	4	16	--	--	4	56	--	100
7	--	4	--	--	--	36	--	60
8	--	4	--	--	--	28	--	20
9	--	--	--	20	--	8	--	--
10	--	--	--	--	--	4	--	--
13	--	--	--	--	--	4	--	20
Total	452	3,788	1,220	4,960	136	2,648	180	2,260
Percent	12	100	25	100	5	100	8	100

1/ Average of five 1/20-acre plots within a 2.5-acre cutting.
2/ Sample composed of one 1/20-acre plot in an uncut area.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
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No. 361

Construction of the Lake States Deer Exclosure

To study and demonstrate the effects of browsing on forest vegetation, it has been found useful to establish exclosures which keep deer and snowshoe hares out of small areas in the forest. A type of exclosure which has been found satisfactory in the Lake States is described below. (See plan on back of page.)

The exclosure should be 40 feet by 40 feet in outside dimension. A check plot of similar size should be established immediately adjacent or nearby under comparable conditions. The exclosure is enclosed to a height of approximately 9 feet by a fence made up of two sections of 47-inch woven wire which are joined together with hog rings. One strand of 9-gauge wire is fastened to the posts about 1 foot above the woven wire fence. Poultry netting of 1- or 2-inch mesh, 4 or 5 feet high, should be attached to the lower part of one half of the exclosure fence. It must be attached outside the woven wire fence so as to produce double fencing for one half of the exclosure. The poultry netting across the center should be supported by three 7-foot center line posts, the two outside fence posts, and a single strand of 9-gauge wire stretched a few inches above the netting and fastened together with hog rings. To make half the exclosure hare-proof, all fencing should be flush with the ground. The vegetation and soil within and around the exclosure should be disturbed as little as possible during construction. Durable posts, either of peeled white-cedar or tamarack or of other species suitably treated with preservatives, should be used.

To facilitate access to the exclosure, wooden ladders, attached to the fence, should be constructed in one corner. Two similar smaller ladders will be needed to cross over the hare-proof fence within the exclosure. Where used for public demonstration, explanatory signs should be established at each exclosure. Vegetation records should be taken on milacre plots within each half of the exclosure and on the control plot at the time of establishment and at periodic intervals. Photographs should also be taken at established photographic points.

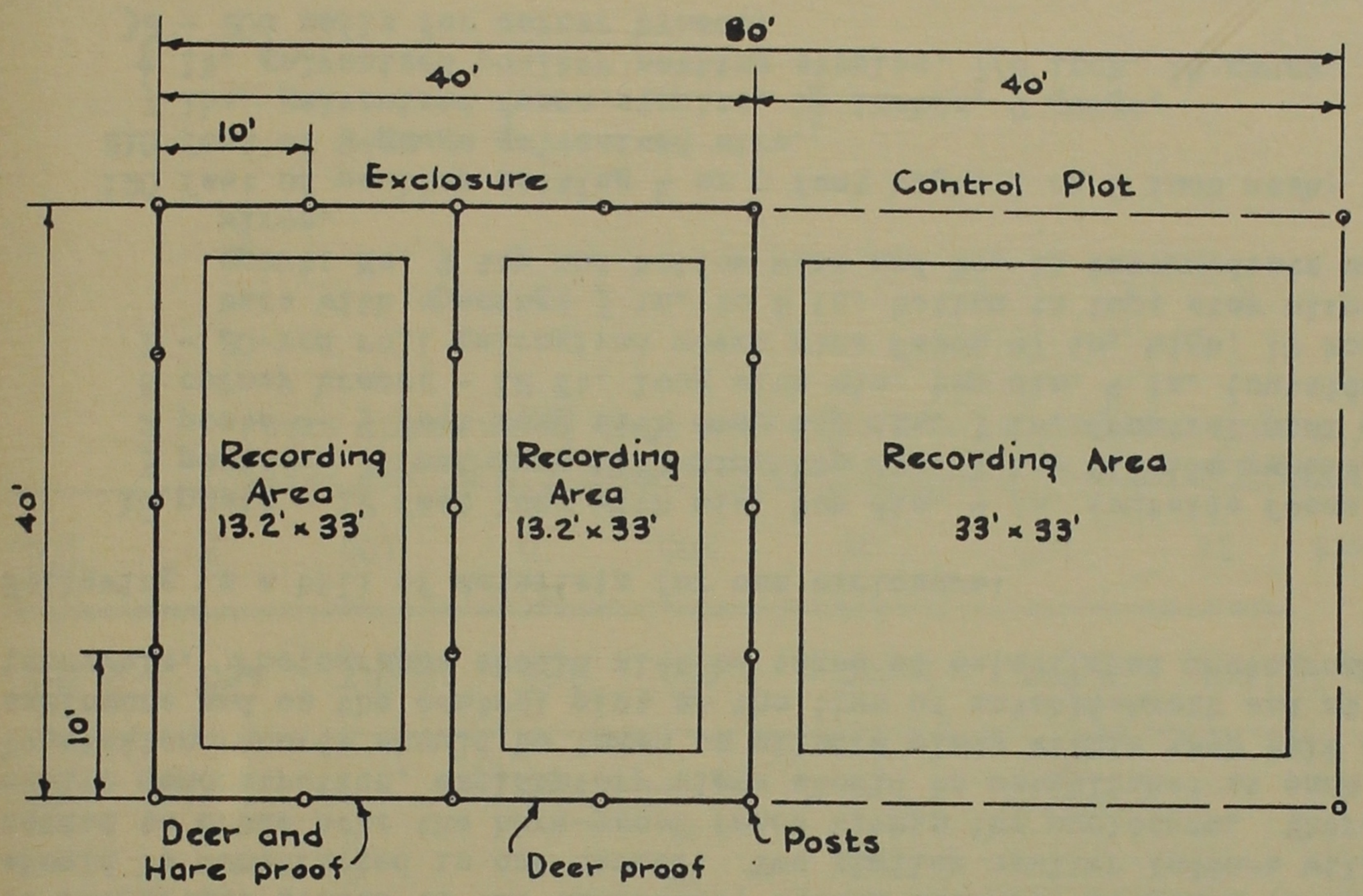
Following is a bill of materials for one exclosure:

16 posts - 12 feet long with min. top dia. 4 in. (outside fence).
3 posts - 7 feet long with min. top dia. 3 in. (inside rabbit fence).
2 posts - 5 feet long with min. top dia. 3 in. (control plot corners).
8 corner braces - 12 ft. long with min. top dia. 4 in. (outside fence).
1 - 20-rod roll galvanized woven wire fence 47 in. high; 10 horizontal bars with spacings 3 in. to 8 in. bottom to top; stay wires 6 in. apart; No. 9 top and bottom wire and No. 11 intermediate and stay wires.
120 feet of poultry netting 4 or 5 feet high; 1 or 2 inch mesh; 20 gauge.
210 feet of 9-gauge galvanized wire.
7 lbs. galvanized fence staples, 1½ inches, 9 gauge.
½ lb. galvanized poultry netting staples, 7/8 inch, 14-gauge.
32 - 20d nails for corner braces.

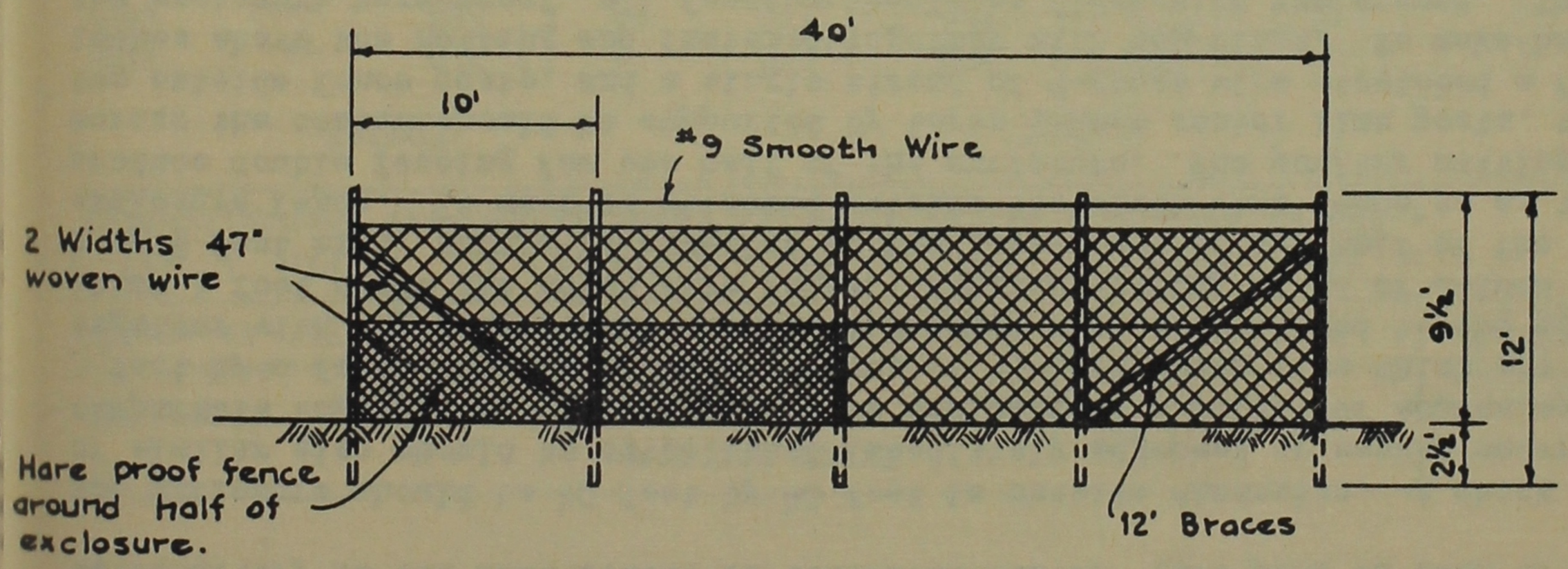
LAURITS W. KREFTING, Biologist

October 1951

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA



PLAN VIEW
1" = 16'



ELEVATION
1" = 10'

DETAILS OF EXCLOSURE CONSTRUCTION

U.S.D.A., Soil Conservation Service, Milwaukee, 1951

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 362

Bark Percent in Lake States Trees

Rough wood volumes can be converted to peeled wood volumes if the amount of bark in percent of total stem volume is known. The table below shows such proportions in terms of volume for common tree species in the Lake States. Although it is recognized that percent of bark varies considerably both by localities and with tree diameter, stand density, site, etc., only regional averages for three stand sizes are shown.

Proportion of bark to total cubic volume outside bark
by species and stand size

Species	Stand size: Pole timber (4-10 inches)	Saw timber (12 inches and larger): Second growth	Saw timber (12 inches and larger): Old growth
	Percent	Percent	Percent
Conifers			
Balsam fir	12	12	-
White cedar, No.	14	14	14
Hemlock	17	17	19
Pine			
Jack	17	14	10
Red	16	13	11
White	14	16	18
Spruce			
Black	12	11	-
White	15	12	10
Tamarack	12	11	-
Hardwoods			
Ash			
Black	16	15	14
Green	17	16	19
White	17	16	19
Aspen	13	13	-
Basswood	18	20	20
Beech	8	8	7
Birch			
Paper	11	12	-
Yellow	13	15	15
Cottonwood	17	17	18
Elms	17	18	19
Hickories	15	16	-
Maple			
Red	15	15	14
Sugar	15	17	18
Oaks			
Red	18	20	20
White	20	20	22

S. R. GEVORKIANTZ, Forester
L. P. OLSEN, Statistician

October 1951

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 363

Successful Natural Jack Pine Regeneration

That jack pine regeneration can be obtained through the ground scarification - slash scattering method is shown by ten-year results of large scale field trials comprising 450 acres on the Chippewa National Forest in northern Minnesota. On this area adequate stocking for early management was secured under average conditions through efficient field work.

A 200-acre tract was clear-cut during the winter of 1939-40. The slash was bunched progressively. The area between slash piles was cross-disked in April 1940 using an Athens disk-plow so that about 60 percent of the mineral soil surface was exposed. The cone-bearing slash was immediately scattered evenly over the scarified soil. The second 250-acre tract was treated in the same manner in 1940-41. Seed spotting was used in small areas lacking enough cones, but not in the vicinity of the permanent reproduction quadrats.

The original stand was overmature pure jack pine from 80-120 years old. The site was a light sandy soil well suited to this species. The underbrush, predominantly hazel, was of light to moderate density. Germination conditions were good in 1940, but so poor in 1941 that much of the seed held over until 1942 (no field counts made in 1942).

A summary of the results after ten years follows:

Tract	Total stems per acre			Quadrat stocked			Ave. height dominants
	1940	1941	1950	1940	1941	1950	1950
	Number			Percent			Feet
1	7,930	4,100	3,270	86	84	68	7.1
2	-	1,975	3,015	-	65	72	8.3

Basis: Tract 1 - 100 milacre quadrats.
Tract 2 - 200 milacre quadrats.

This method should be successful on most jack pine sites if (1) at least 60 percent of the mineral soil is exposed, (2) sufficient good cones are available in the slash, (3) cones are scattered only on exposed soil, and (4) scattering is performed early in the spring or late in the fall so that fall germination and over-winter losses are minimized.

October 1951

R. A. RALSTON, Research Forester

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 364

Lake States Pulpwood Production Reverses Trend, 1950

A recent canvass made by the Station shows that Lake States pulpwood production amounted to approximately 1,872,000 cords during 1950 compared with 1,552,000 cords in 1949. Of the regional total, Minnesota produced about 40 percent, Michigan 35 percent, and Wisconsin 25 percent. Although pulpwood cutting was substantially increased over the previous year, it did not reach the high yearly average of 2,150,000 cords attained during the 1946-1948 period.

Aspen continued to be the principal pulpwood species, accounting for about 37 percent of the total volume produced in the region. Of the 50 mills operating in the Lake States, all but 7 used aspen in varying amounts for the manufacture of pulp. Use of other species of hardwoods increased more than six-fold during the past 5 years.

In addition to local species, Lake States mills obtained 490,000 cords from Canada and 65,000 cords from the western states in 1950. Wood imports from Canada were the lowest in years, but the opposite was true of western pulpwood, shipments of which were the highest on record.

Production and Imports of Pulpwood, Lake States - 1950

Species and destination	Source of wood (Lake States)				Imports			Total receipts
	Minn.	Wis.	Mich.	Region	U.S. 1/	Canada	Total	
	Standard cords (rough wood basis)							
Aspen								
Minn. mills	226,194	8,716	-	234,910	-	31,886	31,886	266,796
Wis. "	21,814	185,806	178,647	386,267	-	955	955	387,222
Mich. "	-	-	65,359	65,359	-	21,658	21,658	87,017
Other " 2/	-	-	7,300	7,300	-	-	-	-
Total	248,008	194,522	251,306	693,836	-	54,499	54,499	741,035
Balsam fir								
Minn. mills	40,691	-	-	40,691	-	113	113	40,804
Wis. "	85,268	69,064	81,407	235,739	-	2,508	2,508	238,247
Mich. "	-	-	41,558	41,558	-	18,400	18,400	59,958
Total	125,959	69,064	122,965	317,988	-	21,021	21,021	339,009
Birch								
Minn. mills	-	-	-	-	-	-	-	-
Wis. "	82	5,735	4,431	10,248	-	-	-	10,248
Mich. "	-	-	1,015	1,015	-	-	-	1,015
Total	82	5,735	5,446	11,263	-	-	-	11,263

A. G. HORN, Forest Economist

October 1951

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

(Over)

Species and destination	Source of wood (Lake States)				Imports			Total receipts
	Minn.	Wis.	Mich.	Region	U.S.1/	Canada	Total	
	Standard cords (rough wood basis)							
Cedar								
Minn. mills	-	-	-	-	-	-	-	-
Wis. "	-	-	-	-	-	-	-	-
Mich. "	-	-	104	104	-	-	-	104
Total	-	-	104	104	-	-	-	104
Hemlock								
Minn. mills	-	-	-	-	-	-	-	-
Wis. "	-	47,151	44,272	91,423	-	-	-	91,423
Mich. "	-	-	39,962	39,962	-	-	-	39,962
Total	-	47,151	84,234	131,385	-	-	-	131,385
Pine								
Minn. mills	123,602	-	-	123,602	-	53,854	53,854	177,456
Wis. "	59,877	92,815	13,393	166,085	49,115	28,288	77,403	243,488
Mich. "	3,284	-	52,497	55,781	-	10,382	10,382	66,163
Total	186,763	92,815	65,890	345,468	49,115	92,524	141,639	487,107
Spruce								
Minn. mills	83,885	-	-	83,885	-	24,558	24,558	108,443
Wis. "	101,838	31,402	68,739	201,979	13,053	225,728	238,781	440,760
Mich. "	-	-	29,770	29,770	-	71,308	71,308	101,078
Total	185,723	31,402	98,509	315,634	13,053	321,594	334,647	650,281
Tamarack								
Minn. mills	941	-	-	941	-	-	-	941
Wis. "	198	296	171	665	2,460	-	2,460	3,125
Mich. "	-	-	-	-	-	-	-	-
Total	1,139	296	171	1,606	2,460	-	2,460	4,066
Misc. hardwoods								
Minn. mills	3/637	-	-	637	-	-	-	637
Wis. "	-	19,990	500	20,490	29	-	29	20,519
Mich. "	-	-	27,454	27,454	-	-	-	27,454
Total	637	19,990	27,954	48,581	29	-	29	48,610
Waste (slabs, etc.)								
Minn. mills	-	-	-	-	-	-	-	-
Wis. "	-	6,577	-	6,577	-	-	-	6,577
Mich. "	-	-	-	-	-	-	-	-
Total	-	6,577	-	6,577	-	-	-	6,577
All species								
Minn. mills	475,950	8,716	-	484,666	-	110,411	110,411	595,077
Wis. "	269,077	458,836	391,560	1,119,473	64,657	257,479	322,136	1,441,609
Mich. "	3,284	-	257,719	261,003	-	121,748	121,748	382,751
Other "	-	-	7,300	7,300	-	-	-	-
Total	748,311	467,552	656,579	1,872,442	64,657	489,638	554,295	2,419,437

1/ All western wood except 29 cords of miscellaneous hardwoods from East.
2/ Pulpwood produced in region and shipped to mills outside of Lake States.
3/ Balm of Gilead.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 365

Some Effects of Soil and Topography on Oak Yields in Southern Michigan

Combinations of soil texture and topography, as they affect soil moisture, are the principal site factors influencing the growth and yield of red and black oaks in southern Michigan according to a study completed by the Lake States Forest Experiment Station and Michigan State College. The clay content of the soil is usually related directly to the amount of moisture retained in the soil. The importance of the clay content where the influence of slope and topographic positions are negligible as on flat land is illustrated in the following table:

Soil texture	Yield of average dominant and co-dominant tree at 40 years		60 years		80 years	
	Cu.ft. 4/	Bd.ft. 5/	Cu.ft.	Bd.ft.	Cu.ft.	Bd.ft.
Heavy textured soils 1/	19	56	33	105	56	210
Medium textured soils 2/	13	28	18	45	26	75
Light textured soils 3/	8	-	12	24	15	32

When these same textured soils occur on slopes, topographic position and percent of slope also affect the yields of oak, as shown below:

Soil texture	Topographic position	Yield ave. dominant & co-dominant tree at 60 years: Moderate slopes (6-20%)		Steep slopes (30%+)	
		Cu.ft. 4/	Bd.ft. 5/	Cu.ft.	Bd.ft.
Heavy 1/	Upper slopes	24	70	19	45
	Middle slopes	24	70	24	70
	Lower slopes	24	70	24	70
Medium 2/	Upper slopes	19	45	15	28
	Middle slopes	19	45	19	45
	Lower slopes	24	70	24	70
Light 3/	Upper slopes	9	16	9	16
	Middle slopes	15	28	15	28
	Lower slopes	19	45	24	70

1/ Soils which range from clay to moderately heavy loams throughout the profile. (Examples: Miami and some Hillsdale soils).
2/ Generally sandy in the surface layers; the subsurface is also sandy, but has a cemented layer of small amounts of clay at 12 to 20 inches from the surface. (Example: Bellefontaine soils.)
3/ Sandy throughout the entire profile. (Examples: Coloma and Plainfield soils.)
4/ Total volume of stem less bark. USDA Bulletin No. 560.
5/ International 1/4-inch rule. Form class 78.

The degree of slope has considerable effect on surface and subsurface drainage and the position on the slope determines whether soil moisture is lost or gained as a result of drainage. Thus oak yields are low on light sandy soils and upper slopes where moisture can drain away. However, on lower slopes where drainage is impeded and the soil moisture can be replenished from above, the yields of oak are high regardless of the soil texture.

JOHN L. AREND
Research Forester
L.S.F.E.S.

LESLIE W. GYSEL
Collaborator
Michigan State College

October 1951

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 366

Thinning Young Oak Stands for Fuel

Well-stocked stands of northern red oak often stagnate in the late sapling and early pole stage unless they are thinned. Experience at the Upper Mississippi Valley Soil Conservation Experiment Station, La Crosse, Wisconsin, indicates that farmers can thin such stands and obtain a reasonable labor return from the fuel wood obtained while improving growth possibilities.

In 1931, a series of 1/10-acre permanent sample plots was established in a 40-year-old mixed-oak forest on the 160-acre experimental farm. Measurements early in 1947 (age 55) showed that the diameter growth rate for the final 15-year period was only 50 percent that of the mean rate during the first 40 years in the life of the stand. Consequently, six plots were remeasured in 1948 and marked for cutting. The gross volume per acre at that time was 40.1 cords; the basal area, 112 square feet; the total number of live stems, 294; and the average diameter, 8.4 inches. These values are based on all living trees 1.6 inches d.b.h. and larger. The thinning removed 137 stems per acre averaging 7.1 inches in diameter and having a total basal area of 37 square feet. After treatment, there remained 157 trees per acre. They averaged 9.4 inches at d.b.h. and had a total basal area of 75 square feet. The majority of trees cut was in the suppressed or intermediate classes. In terms of total basal area, northern red oak comprised 84 percent of the unthinned stand, 81 percent of the stems which were cut, and 86 percent of those which were left. Other species included white oak, bitternut and shagbark hickories, bigtooth aspen, paper birch, black walnut, butternut, black cherry, and boxelder.

The foreman of the experimental farm felled the trees on an area of 1.33 acres and cut them into 12- and 16-foot lengths. The operator estimated that he obtained 15 standard cords of 16-inch dry blocks from the pole wood. Ninety-five percent of this volume was from live trees. The balance was from dead stems averaging 3.9 inches in diameter. Its equivalent value in soft coal at $13.00 per ton would be $195.00. If 15 hours of farm-tractor time at $1.00 per hour and the use of a home-made "saw rig" for 5½ hours at $0.50 per hour are charged as an expense, the cash return amounts to $177.25. The labor requirement was 86 hours in the woods, 15 hours for hauling, and 27 hours for sawing block wood, or 128 total. Thus, for each hour of labor expended, the operator recovered products having a gross value of $1.38. The corresponding net return, if records were available to determine it, would be substantially what the farmer received for his work. To obtain this figure, the value of the standing timber harvested plus a pro-rata share of the principal and interest chargeable for taxes and other annual expenses during the 55-year period would have to be deducted from the $177.25. However, the main point of this study is that this kind of wood-lot management can be done by hundreds of farmers throughout the region with the tools and hauling equipment they already have and with a minimum of technical forestry assistance. The value of the thinning as a stimulus to the remainder of the stand can be determined only by later measurements.

HAROLD F. SCHOLZ, Research Forester

January 1952

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION

U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE

UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 367

Some Costs and Effects of Chemical Release of Pine in Northern Michigan

During 1950, the following methods of releasing pine from overtopping hardwoods were tested on the Lower Michigan National Forest: (1) the regular ax treatment in which the smaller trees are cut and the larger ones girdled, (2) ammonium sulfamate (ammate) crystals applied to notches or cups at the base of the hardwood trees, and (3) basal sprays using three different herbicides - 2,4-D (Esteron 44), 2,4,5-T (Esteron 245), and a combination of the two (Esteron Brush Killer) - in a 2-percent solution (by volume) of diesel oil.

The release tests were conducted in two different stands consisting mainly of 500 to 600 scrub oaks, aspen, and red maple under which red pine was underplanted in 1940. The size of the overstory trees ranged from 1 to 12 inches in diameter although the average diameter was only about 4 inches. Six to eight acres each were treated in the winter, spring, summer, and fall. The labor and material required are shown below:

Release method	Cost items			
	Actual time required		Amount of herbicide	
	Per acre	Per sq. ft. basal area	Per acre	Per sq. ft. basal area
	Man-hours	Man-hours	Gallons	Gallons
Cutting by ax	7.80	0.21	--	--
"Ammate" in notches	10.40	0.27	1/25	1/0.65
Basal spray2/ for 4 feet	5.25	0.13	20	0.48
Basal spray2/ for 2 feet	2.80	0.05	12	0.23

1/Pounds, not gallons. 2/Hormone herbicides (Esteron 44,245,and Brush Killer).

With the ax method, trees less than 4 to 5 inches in diameter were cut and those larger than this diameter were girdled. Sprouts from the treated trees grew 1 to 3 feet the first year after treatment.

Ammate crystals were placed on the cut stumps of trees under 3 to 4 inches in diameter and in the cups at the base of the larger trees by a 3-man crew (2 axmen and 1 man handling the ammate crystals). Nearly 100 percent top kill was obtained on all species treated. Some trees, especially aspen, sprouted the second year.

The treatments in which the tree stems were sprayed to a height of 4 feet resulted in a 70 to 100 percent top kill, varying somewhat with the chemical used, season of the year, species, and size of tree. However, when the tree stems were sprayed to a height of 2 feet, only the Esteron 245 in diesel oil resulted in an equivalent top kill throughout the year. Nevertheless, except for aspen treated during the early spring season, sprouting was largely controlled.

Although basal sprays can be used to control most hardwoods in northern Michigan, their general use on trees above 4 to 6 inches in diameter is not yet recommended for extensive pine release work because of the volume of herbicide required.

JOHN L. AREND, Res. For.
LSFES

JOSEPH R. STEPHENSON, Dist.
Ranger, Lower Michigan NF

January 1952

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 368

Is the Growth of Jack Pine Reproduction Affected by Age of Parent Tree?

That the development of jack pine seedlings apparently is not affected by the age of the parent tree has been brought out by a study started in Lower Michigan in 1937.

Seed was collected from trees ranging in age from 10-80 years from several stands on the Huron division of the Lower Michigan National Forest. In May 1940, 50 sample 2-0 seedlings selected at random from each age class of parent trees were bar-planted in adjacent furrows in Grayling sand. The plantation has received no release or other treatment since establishment as both overhead and ground cover have been sparse. Damage caused by the pine weevil (*Pissodes strobi*) has been extensive but uniform. The results after 14 growing seasons from seed are summarized below:

14 years' growth	Age class of parent trees - years						
	11-20	21-30	31-40	41-50	51-60	61-70	71-80
Average total height (feet)	13.9	13.9	14.0	13.8	13.7	13.9	13.6
Average d.b.h. (inches)	2.0	2.0	1.9	1.9	1.9	1.9	1.9

Although slight variations in early development were observed, these apparent differences have been resolved now that the seedlings are firmly established.

Similar results were obtained in northern Minnesota using jack pine seed from cones of various ages but from trees of one age class (Lake States Forest Experiment Station Technical Note No. 358).

The results of these studies indicate that once jack pine seedlings become established future differences in growth or development probably cannot be attributed to either age of parent seed or age of parent tree.

January 1952

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MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 369

More Ungrazed Farm Wood Lots in Minnesota

The area of farm woodland not grazed by domestic livestock in Minnesota increased more than 40 percent from 1935 (1,214,239 acres) to 1950 (1,743,091 acres) - according to data from the U. S. Census of Agriculture. The increase in ungrazed area was consistent for all county groups except those in the prairie areas of southwestern Minnesota and the Upper Minnesota River Valley where the trend was reversed (see table below).

Area of Ungrazed Farm Woodland in Minnesota

Area1/	Counties	Ungrazed woodlands2/	
		19353/	19504/
	Number	Acres	Acres
Southwestern Minnesota	10	13,258	10,297
Upper Minnesota Valley	10	25,568	17,380
Mankato	9	36,923	39,478
Big Woods	7	24,329	33,858
Twin City	5	26,490	38,145
Red River Valley	10	259,586	397,137
Lake Region	4	57,758	87,337
Southeastern Minnesota	8	85,226	127,790
Cambridge	4	45,833	72,362
Little Falls	5	67,072	111,970
Northeastern Minnesota	5	178,364	234,598
Central Pine	8	296,382	458,500
Rainy River	2	97,450	114,239
Total State	87	1,214,239	1,743,091

1/ For this analysis the state was divided into groups of counties similar in topography, soil conditions, timber types, and climate. A map showing boundaries of these areas will be found on the back of this page.

2/ Includes woodland fenced against livestock and that too wet or too steep to graze.

3/ U. S. Census of Agriculture, 1935.

4/ Preliminary Report U. S. Census of Agr., 1950.

These figures seem to indicate progress in developing a management program for farm wood lots because protection of the farm woods from grazing is one of the first requirements of such a program.

January 1952

JOHN R. NEETZEL, Forester

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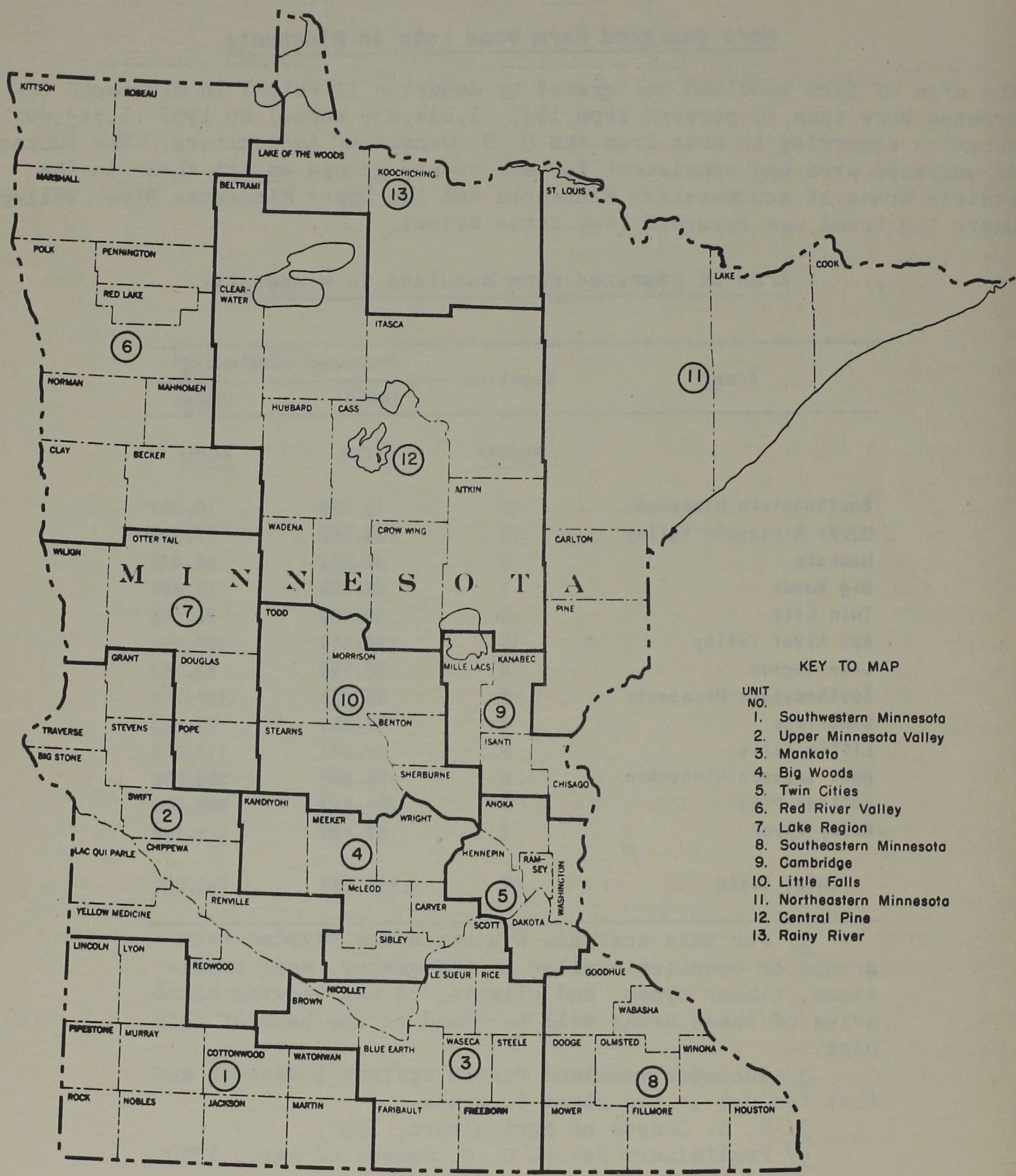
MINNESOTA FARM WOODLAND UNITS



KEY TO MAP

UNIT NO.

1. Southwestern Minnesota
2. Upper Minnesota Valley
3. Mankato
4. Big Woods
5. Twin Cities
6. Red River Valley
7. Lake Region
8. Southeastern Minnesota
9. Cambridge
10. Little Falls
11. Northeastern Minnesota
12. Central Pine
13. Rainy River

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 370

1951 Tree Seed Crops Poor to Fair in the Lake States

Most forest trees in the Lake States produced poorer seed crops in 1951 than in 1950, although somewhat better than in 1949, according to estimates made at five field branches of the Lake States Forest Experiment Station.

Seed production was generally better in Wisconsin than in Minnesota or Michigan (see table on back of sheet). In northeastern Wisconsin, only basswood produced a bumper seed crop, but red pine, jack pine, Scotch pine, quaking aspen, bigtooth aspen, and northern red oak had good crops. Northern white-cedar, tamarack, red maple, yellow birch, black ash, and black cherry had fair seed production, but all other species had poor or failed crops.

In southern Wisconsin, seed crop production was bumper for shagbark hickory and bitternut hickory, good for northern red oak and black oak, and fair for all other species except eastern white pine, sugar maple, and slippery elm which had poor crops and Norway spruce which had a crop failure.

In northern Minnesota, basswood had a good seed crop, but all other species had fail crops except the pines, black spruce, paper birch, and quaking aspen which varied from fail or poor to fair. Generally, seed production was somewhat poorer in the Koochiching County area and the Ely area than it was along the north shore of Lake Superior or the Chippewa National Forest.

The only species with good seed production in central Upper Michigan was red pine. All other species bore poor crops except sugar maple, which had a fail crop.

In the Lower Peninsula of Michigan, good seed crops were borne by red pine, red maple (in the south half), northern red oak, and white oak (in the north half). Except for eastern white pine and northern white-cedar which produced fair seed crops, all other species had poor crops.

With a few exceptions, the 1951 tree seed crop in the Lake States appears to be inadequate for good natural reproduction and only poor to fair for commercial seed procurement and sustenance of seed-eating birds and mammals.

January 1952

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MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Table 1.--Forest tree seed crop reports in the Lake States, 1951

Species	Estimated percentage of a full crop[1] in --				
	Northern Minnesota	N. E. Wisconsin	S. W. Wisconsin	Central Upper Mich.	Lower Pen. Michigan
Red pine	37-50	75	(2/)	75	75
Eastern white pine	7-25	25	25	25	50
Jack pine	50	75	50	--	--
Scotch pine	--	75	--	--	--
White spruce	7	7	--	25	25
Black spruce	25-50	25	--	25	25
Norway spruce	--	25	7	--	--
Balsam fir	7	7	--	25	25
Eastern hemlock	--	25	--	25	--
Northern white-cedar	7	50	--	25	50
Tamarack	7	50	--	--	--
Sugar maple	--	25	25	7	--
Red maple	--	50	--	25	3/75
American beech	--	--	--	25	3/25
Basswood	75	95	--	--	--
Yellow birch	--	50	--	25	--
Paper birch	7-50	25	--	--	--
Quaking aspen	25-50	75	--	--	--
Bigtooth aspen	--	75	--	--	--
American elm	--	--	50	25	3/25
Slippery elm	--	--	25	--	--
White ash	--	25	50	--	--
Black ash	7	50	--	25	--
Northern red oak	--	75	75	--	75
Black oak	--	--	75	--	--
White oak	--	--	50	--	3/25-4/75
Bur oak	--	--	50	--	--
Black cherry	--	50	--	--	--
Shagbark hickory	--	--	95	--	--
Bitternut hickory	--	--	95	--	--
Black walnut	--	--	50	--	--
Butternut	--	--	50	--	--

1/ Failure: 0-15 percent of a full crop.
Poor: 16-35 percent of a full crop.
Medium: 36-60 percent of a full crop.
Good: 61-90 percent of a full crop.
Bumper: 91-100 percent of a full crop.

2/ Signifies no report on this species.

3/ South ½ Lower Peninsula.

4/ North ½ Lower Peninsula.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 371

Second-Growth Woodland Can Be a Financial Asset to the Farm

Results of the first five years' cutting on the 40-acre second-growth wood lot at the Upper Peninsula Experimental Forest at Dukes, Michigan, show that substantial hourly returns can be realized annually under proper management.

This tract of second-growth hardwoods (predominantly sugar maple), logged over 35 to 40 years ago, was divided into five compartments of 8 acres each. An improvement cutting was made over the area, each compartment being cut once during the past five years. Removed were many of the old logging remnants and some of the younger trees of poor form and quality plus a small volume of mature balsam fir and spruce.

An average of 343 board feet net of sawlogs, 1.42 cords chemical bolts, 1.16 cords chemical wood, and 1.00 cord of pulpwood were cut per acre over the 5-year period. Total and hourly returns were as follows:

Year	Roadside value of products 1/	Skidding costs 2/	Net return 1/	Time worked	Returns per man-hour
	Dollars	Dollars	Dollars	Hours	Dollars
1946	313.73	59.40	254.33	208	1.22
1947	317.76	68.60	249.16	227	1.10
1948	323.87	27.00	296.87	220	1.35
1949	367.48	30.00	337.48	281	1.20
1950	407.10	24.78	382.32	251	1.52
Total for 5 years	1,729.94	209.78	1,520.16	1,187	-
Average per year	345.99	41.96	304.03	237.4	1.28

1/ Includes stumpage value.
2/ Includes tractor or horse and also hired teamster in 1946, 1947, and 1948.

The 40 acres have produced a net return of $1,520.16 over the 5-year period for an average hourly wage to the farmer-operator of $1.28. Stumpage estimated at not more than $30.00 per year is included in the return. Interest on the investment in land and taxes of about $6.00 a year have not been considered. Due to economic changes, the $1.22 hourly return in 1946 is about equal in purchasing power to the $1.52 return in 1950.

Each acre of timber provided approximately 6 hours of labor annually. On this basis, approximately 350 acres of second-growth timber of this type would annually provide one man-year of labor at a return of $9.12 per acre or almost $3,200.00 annually (using 1950 product values).

April 1952

F. R. LONGWOOD, Research Forester

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 372

Disking to Regenerate Pulpwood Species

Disking is becoming an accepted practice with some managers of pulpwood lands in the Lake States as a relatively inexpensive means of regenerating understocked aspen stands. Besides aspen, other species may also arise from natural seeding in such disked tracts.

An excellent example of such natural seeding was noted in a cooperative study in northeastern Wisconsin on the industrial forest of the Rhinelander Paper Company. In August 1950, disking was done at intervals of 10 feet in a thin, patchy stand (about 100 trees per acre) of 1- to 5-inch diameter balsam fir and 2- to 8-inch paper birch. There was a bumper crop of seed at the time of disking. The work was done with a heavy disk about 6 feet wide and weighing 1,400 to 2,000 pounds, drawn by a caterpillar-type tractor. The cost of disking ranged from $4 to $7 per acre.

On August 29, 1951, a stand of 307,900 new seedlings per acre was observed in the strips churned up by the disk. Almost no seedlings came in on the undisked area. Making due allowance for the undisked strips (40 percent of the gross area within boundary of the disking), there were 184,740 trees per gross acre of disking. Stocking and distribution by species on disked portions of tract are shown in the table below:

Species	Quadrats stocked	Seedlings per acre: Disked strips	Seedlings per acre: Total area
	Percent	Number	Number
Paper birch	82.5	288,600	173,160
Balsam fir	57.5	14,100	8,460
Red maple	32.5	3,900	2,340
Aspen	12.5	1,200	720
Spruce	2.5	100	60
All trees	95.0	307,900	184,740

Rather heavy mortality is to be expected and is needed to thin out the seedlings. Heavy deer browsing is anticipated (and hoped for) to reduce the ratio of birch to balsam fir because the latter is the more favored of the two species for pulpwood.

This natural reseeding was successful because of a combination of a bumper seed crop, adequate numbers of seed-bearing trees per acre, mineral soil exposure shortly before seed fall, and abundant rainfall in the first-year growing season.

April 1952 J. H. STOLCKELER, Forester

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 373

Seed Production of a White Spruce Tree

White spruce, one of the most valuable and widely planted Lake States conifers, normally produces heavy crops of seed every 2 to 6 years and lighter crops in most intervening years. Little is known, however, as to the total amount of seed produced by trees of this species in good years. Therefore, data collected on the Kawishiwi Experimental Forest near Ely, Minnesota, should be of interest since it shows how much seed an individual spruce can produce in a heavy crop year.

Following the seed crop of 1948, a careful count was made of all the cones produced by an isolated, open-grown white spruce 15 inches in d.b.h. and about 75 years old. Squirrels began to cut off the cones on August 25, and on September 2 a sample of 20 such cones (dropped but not otherwise disturbed) was taken at random. These were opened slowly by artificial heat and the seed obtained was stored at ordinary temperatures until November 6. At that time it was placed - wings and all without cleaning - on moist filter paper in petri dishes and prechilled for about two months at 41°F. Following this treatment, the seed was germinated at 70° - 80° F. for a period of 19 days. All seeds remaining ungerminated at the end of the germination period were then cut open to determine the number of sound ungerminated seeds.

Of the 1,306 seeds contained in the 20 cones, 414 germinated and 43 others were still germinable at the end of the test. The average production per cone was, therefore, 22.8 viable seeds.

Cone fall continued throughout the fall of 1948 and during the following winter, summer, and fall. The total production of 1948 cones was found to be 11,874 cones, of which all but about 650 had fallen by June 30, 1949. Applying the average yield per cone to the total cone production gives a total yield from this one tree of more than 271,000 viable seeds in 1948, the equivalent of about one pound of commercial clean seed.

This tree bore a heavy crop of cones in 1944, lighter crops in 1946 and 1947, a medium crop in 1950, but no cones in 1945 or in 1949. Trees of comparable age and size would, of course, produce fewer cones under stand conditions, but it is apparent that mature white spruce trees in northern Minnesota can produce a large number of viable seeds in good crop years.

April 1952

EUGENE I ROE, Research Forester

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 374

Labor Costs for Thinning Young Aspen

Silviculturally it is desirable to thin overdense young quaking aspen stands on good sites at an early age according to studies made by the Station in northern Minnesota over the past 23 years. Economically the desirability of such thinnings will depend upon increased values resulting from the treatment weighed against the cost of thinning carried over the period. Below are data from two noncommercial thinnings made by small crews of local men (employed at hourly wages) in 11- and 20-year-old aspen stands.

Labor Required in Two Noncommercial Aspen Thinnings

Age of stand when thinned (Years)	Tools used	Area thinned	Stems per acre		Size of stems removed	Labor required per acre
			Left	Removed		
		Acres	No.	No.	Inches	Man-hours
11	Brush knives	20.0	742	2,115	1 - 2	11.2
20	Axes	5.8	1,624	588	2 - 5	16.8

Two distinctly different types of thinning are represented by these data: (1) a thinning in an 11-year-old stand which removed all except 600 to 900 of the best trees per acre and (2) a thinning in a 20-year-old stand which removed only the dominant and codominant trees that were interfering with selected crop trees. In the older stand the trees removed were large enough so that they had to be cut with axes. More time was required to thin the older stand even though far fewer stems were cut. Several types of brush knives were used in the 11-year-old stand, but, while all were superior to axes, none seemed entirely satisfactory. There is need for a special tool for thinning small aspen.

These data indicate that thinning costs at about age 10 are much lower than at 20 years. Even if costs at present wage rates are projected at 5 percent compound interest, the earlier thinning still is more economical. Furthermore, with the early thinning the stand is given 10 additional years in which to respond to management.

April 1952

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 1, MINNESOTA
No. 375

A Mill-Scale Log Rule

There are many log rules but no single one has yet been found entirely satisfactory to the lumber industry. Furthermore, many different rules developed in the past assume different utilization factors which seldom fit the actual mill recovery. A generalized rule is here suggested which can bring more uniformity in the estimation of probable yields of round logs and throw more light on mill-scale studies. The rule is:

$$M = \frac{DL}{20} \cdot (D - f)(1 - c), \text{ where}$$

D = top d.i.b. of log (in inches)
L = length of log (in feet)
c = percent defect (in decimals)
M = estimated mill-tally recovery
f = factor which, if defect is estimated correctly, reflects mill efficiency and sawing practice

Assuming sound logs (c = o), the standard log length (L = 16), and f = 2, this formula gives about the same scale as the International 1/4-inch log rule. If "f" is set at 3, the rule gives the same results as the Scribner formula rule (table 1 on back of page).

By selecting proper values for "f" (either constant or varying by log diameter), one can prepare a rule that will be accurate for any milling job. A few examples are given.

Example 1.--A box-bolt mill in Minnesota sawing 1-inch boards from sound 8-foot bolts under close utilization showed the factor of mill recovery f = 1.4. The generalized rule with f = 1.4 agreed exactly with the mill-tally scale which heavily overran the Scribner decimal rule.

Example 2.--A hardwood mill studied by the Forest Products Laboratory in 1936 indicated "f" factors of 1.6 to 2.0 for different species (table 2). These represented a run of logs from 10 to 18 inches in diameter for which strong data were available.

The factor "f" will vary with the closeness of utilization, thickness of boards, saw kerf, etc. It may also be used as rough index of sawmill efficiency. The value of "f" can be computed as follows:

$$f = D - \frac{20\,M}{LD\,(1 - c)}$$

For example, with M = 168 bd.ft. (mill tally); D = 16 inches; L = 16 feet; and c = .0631 (cull percent = 6.31);

$$f = 16 - \frac{20 \times 168}{16 \times 16 \times (.9369)} = 16 - 14 = 2$$

April 1952

S. R. GEVORKIANTZ, Forester

(over)

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Table 1.--Contents of logs according to various rules

Top diameter of log inside bark (Inches)	International 1/4-inch rule	Generalized rule f = 2	Scribner formula rule	Generalized rule f = 3
	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.
8	40	38	31	32
10	65	64	55	56
16	180	179	166	166
20	290	288	272	272
30	675	672	647	648
40	1,220	1,216	1,180	1,184

Table 2.--"f" factors for some northern hardwood species in one study

Species	Average cull percent	Range of "f" factors	Approximate "f"
Sugar maple	5.1	1.8 - 2.1	2.0
Basswood	12.4	1.9 - 2.1	2.0
Yellow birch	7.9	1.6 - 1.8	1.7
American elm	9.1	1.5 - 1.8	1.6

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 376

The Jack-Pine Budworm -- A Menace to Michigan Jack Pine

The jack-pine budworm, a biological variety of the spruce budworm (*Choristoneura fumiferana* Clem.), has been in outbreak in localized areas of Michigan for the last three years. It has severely defoliated jack pines on the Huron National Forest and on the Au Sable, Higgins Lake, and Ogemaw State Forests in the Lower Peninsula and on the Rapid River Ranger District of the Hiawatha National Forest in the Upper Peninsula.

Substantial losses directly associated with the budworm in Michigan and Minnesota have been reported for jack pine of all size classes. To determine what losses were occurring in jack pine stands infested with budworm on the western third of the Huron National Forest during the last two years, a timber-drain survey was conducted in cooperation with the U. S. Forest Service. The plan of survey was designed to produce results statistically accurate to 8 percent of the total volume on the 109,000 acres of jack pine type within the Forest boundaries. Although losses for which the budworm is solely responsible are not as yet apparent from the findings, mortality in certain classes (see table) is so critical that forest managers should be alert to the menace of continued budworm attack.

Mortality of Jack Pine Infested by Budworm

Tree size class	Tree mortality per acre		
	Average	Range	Proportion of stand
	Number	Number	Percent
Poles	1/ 0.2	1/ 0 - 0.7	3
4-inch saplings	10	0 - 18	8
2-inch saplings	71	20 - 180	33
Reproduction	30	2 - 62	1-42

1/ Cords, not number of trees.

No correlation was found between the severity of budworm defoliation for two seasons and the magnitude of the mortality among poles, saplings, and reproduction. The seriousness of the losses in jack pine during the current outbreak will depend greatly upon the course taken by the outbreak in the next few seasons. Continued defoliation will undoubtedly result in increased losses in the smaller size classes and mortality and top killing among merchantable trees. Should the outbreak diminish or abate, the trees showing the least defoliation will undoubtedly recover and losses become correspondingly less severe. Surveys to follow the course of the outbreak will be conducted in 1952.

Current recommendations for the alleviation of the jack-pine budworm outbreak through management practices include salvage cutting in areas of most severe budworm defoliation and the removal of suppressed and orchard-type jack pine conducive to build-up of budworm populations.

July 1952

DANIEL M. BENJAMIN, Entomologist
U. S. Bureau of Ent. & Plant Quar.

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 377

Understory Balsam Fir Responds Well to Release

Although balsam fir makes fair growth under stands of aspen and paper birch, it will reach pulpwood size considerably faster if released, according to data recently obtained on the Pike Bay Experimental Forest in northern Minnesota.

Early in 1935, a 5-acre understory of small balsam fir in an aspen-birch stand was given complete release by removing all hardwoods. Some 15 cords per acre of box bolts, tie cuts, and fuel wood were cut. This work, done by the Civilian Conservation Corps, also included some thinning of the clumps of balsam, mostly from below. Nothing further was done prior to 1949 when the stand was remeasured. What has happened to the balsam fir during this 15-year period is shown in the following table.

Period	Trees per acre		Basal area	
	Total 1/	Merchantable 2/	Total 1/	Merchantable 2/
	No.	No.	Sq.ft.	Sq.ft.
Before treatment, March 1935	552	291	106	80
After treatment, March 1935	134	71	25	19
December 1949	3/397	3/245	93	76

1/ Trees 4 inches and up.
2/ Trees 6 inches and up.
3/ Eighty-seven percent balsam fir, balance white pine, white spruce, and black spruce.

Because of the excellent growth made during the 15 years since release, the balsam fir had reached merchantable size and provided a cut of 4 to 14 cords per acre. On the surrounding untreated area the balsam fir had made fair growth but was much too small for a merchantable cut.

Further evidence of the beneficial effect of the treatment in stimulating growth is shown by a comparison of the development of sample trees on the two areas. For instance, balsam firs that were in the 4-inch diameter class before treatment 15 years ago are now 7-inch trees and have an average volume of 4.5 cubic feet. On the other hand, the 4-inch trees in the untreated stand grew only 1 inch in diameter in 15 years and have a present average volume of 2.5 cubic feet.

Although the beneficial effect here may have been increased by the thinning, there is no doubt that in such stands release alone would greatly accelerate growth of the balsam. Where there is a demand for aspen and birch pulpwood, the overstory can likely be removed at a profit, thus giving the balsam fir a chance to show its real capacity for growth.

E. I. ROE, Research Forester

July 1952

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 378

Less Oak Reproduction on Better Sites

Both the number and species of oak reproduction vary with the quality of the site according to a study recently completed in southern Michigan by the Lake States Forest Experiment Station and Michigan State College.

In well-stocked, undisturbed oak stands there were from 5 to 17 thousand stems per acre of tree reproduction (trees less than 0.6 inch at d.b.h.), regardless of the site quality. However, the proportion of oak reproduction decreased with increasing site quality as shown below:

Species	Tree reproduction by site class				
	Very poor	Poor	Medium	Good	Very good
	Percent 1/				
Black oak	27	8	3	2	1
Red oak	--	1	4	1	2
White oak	23	6	8	2	1
Subtotal	50	15	15	5	4
Hickory	1	8	10	8	2
Black cherry	8	40	20	30	27
Red maple	--	10	17	5	14
White ash	--	1	2	18	8
American elm	--	--	1	7	11
Red elm	--	2	1	2	1
Sugar maple	--	1	--	--	14
Sassafras	37	8	7	5	3
Hophornbeam	--	1	1	1	4
Flowering dogwood	3	9	8	12	4
Miscellaneous 2/	1	5	18	7	8
Subtotal	50	85	85	95	96
TOTAL	100	100	100	100	100

1/ Percent of total number of tree reproduction tallied.
2/ Includes shadbush, hawthorns, chokecherry, and other noncommercial species.

Because of the large quantity of tree reproduction found on all site classes, there would be enough oak seedlings on the good sites to provide fairly satisfactory stocking of oak if the reproduction were equally distributed. Unfortunately, however, whereas 88 percent of the milacre plots on very poor sites contained at least one oak seedling, only 27 percent did so on the very good sites. Species other than oak, mainly black cherry, red maple, and white ash, predominate among the understory trees except on poor sites. These illustrate some of the difficulties of maintaining oak on good sites.

JOHN L. AREND, Res. For.
Lake States Forest Expt. Station

LESLIE W. GYSEL,
Collaborator
Mich. State College

July 1952

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION

U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE

UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 379

Reproduction After Cutting in Hardwood-Hemlock Stands

Hardwood-hemlock stands will be followed by reproduction adequate in number of trees but less desirable in composition according to a study of three stands recently made by the Station in the Upper Peninsula of Michigan. The three stands had an original volume of about 18 M board feet gross or 11 M board feet net per acre; one was clear-cut; about half the volume was cut in another; and the third was uncut.

In each stand reproduction was tallied by species on 100 quadrats and also by height classes on 20 of these quadrats. The proportion of quadrats stocked with one or more healthy seedlings or saplings by stands was 100 percent on the clear-cut, 99 percent on the partially cut, and 94 percent on the uncut. Red maple reproduction was the most common. Sugar maple was present on 80 to 90 percent of the quadrats in both cut stands. Yellow birch occurred on 88 percent of the clear-cut and 60 percent of the partially cut quadrats but usually was overtopped by red maple and sugar maple. Hemlock was present on 23 percent of the clear-cut and 44 percent of the partially cut quadrats. The amount of reproduction per acre by treatments, species, and size classes is shown below:

Species	Trees per acre by size classes 10 years after treatment when stand was -								
	Clear-cut			Partially cut			Uncut		
	0-1'	1'-5'	5'+	0-1'	1'-5'	5'+	0-1'	1'-5'	5'+
	Number			Number			Number		
Hemlock	200	200	150	650	300	50	1,000	250	50
Sugar maple	2,700	2,300	350	6,250	2,900	450	1,150	650	300
Red maple	15,650	2,550	2,550	27,300	3,000	850	18,900	600	250
Yellow birch	29,600	650	450	13,650	650	--	2,200	600	--
Balsam fir	500	250	200	350	300	--	300	50	50
Beech	--	--	--	2,100	150	--	--	--	--
Misc. spp.	--	--	--	--	--	--	250	100	100
Total	48,650	5,950	3,700	50,300	7,300	1,350	23,800	2,250	750
Treatment totals		58,300			58,950			26,800	

Hemlock and yellow birch constituted over 60 percent of all stems 5 inches d.b.h. and larger in the original forest but are minor species in the new stands. The trend in the reproduction is towards the increase of red maple and sugar maple at the expense of hemlock and birch. Although yellow birch seeds in abundantly after cutting, it has been unable in these areas to compete with red and sugar maples in height growth. Deer browsing, of importance in some localities, has not been a limiting factor. Red maple generally was the dominant species on the cut quadrats, but there was rather uniform distribution of reproduction of other species also.

F. R. LONGWOOD, Research Forester
W. A. SALMINEN, Forestry Aide

July 1952

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 380

Mortality Following Heavy Partial Cutting in a Hardwood-Hemlock Forest

Heavy post-logging mortality generally follows the partial cutting of mature hardwood-hemlock stands. One cutting in Upper Michigan where this did not occur has been studied by the Upper Peninsula Experimental Forest in cooperation with the Cleveland-Cliffs Iron Company.

The stand of mature timber (10.8 MBM net per acre) was given a partial cut in 1944, removing nearly 70 percent of the volume. The residual stand (3.4 MBM net per acre) was concentrated largely in trees less than 20 inches in diameter and of fairly good quality.

Some 198 study trees selected at random along a 40-chain compass line and inspected annually have suffered only a moderate rate of mortality over the 7-year period since cutting and, from all appearances, are now well past any serious loss through post-logging mortality. Only 5 of the trees died as a direct result of exposure and shock. The other 7 were lost by being broken over or uprooted by wind which might have occurred without cutting. Number of trees dying and the gross volume lost are shown in the table below:

Species	Trees included in sample 1/		Average annual mortality over 7 years		
	Sample trees	Volume 2/	Trees dying	Volume 2/	Proportion of sample volume
	No.	Bd.ft.	No.	Bd.ft.	Pct.
Hemlock	95	6,834	1.14	105	1.54
Yellow birch	53	4,075	.14	7	.17
Other species	50	3,282	.43	14	.43
All species	198	14,191	1.71	126	.89

1/ The 198 study trees had a volume equivalent to approximately 3 acres of the residual stand.
2/ Gross board feet Scribner Decimal C.

Annual mortality has occurred at a rate of 0.89 percent of the 1944 residual volume. The gross annual growth has averaged 159 board feet per acre, about four times greater than mortality. Hemlock, as expected, proved to be the most susceptible tree to post-logging mortality, but yellow birch withstood the shock of heavy cutting very well. The heavy cutting which generally left the younger, thriftier, and less defective trees may have been the principal reason for the low rate of mortality, or possibly Lake Superior, less than 3 miles away, had some favorable effect. Mortality has not occurred in sufficient volume to be considered a limiting factor in the partial cutting of this stand.

July 1952

F. R. LONGWOOD, Research Forester

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LAKE STATES FOREST EXPERIMENT STATION
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UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 381

Logging Damage to Reproduction Under Swamp Black Spruce

Swamp black spruce stands cut for pulpwood in northern Minnesota may lose from 1/5 to 1/3 their stocking of advance reproduction according to a study of various methods and intensities of cut made recently on the Big Falls Experimental Forest.1/

Cutting was done in the winter over a period of three years on 17 compartments and by 9 different operators, mostly farmer-loggers. Timber sales were made and administered in the same manner as other small State sales in the vicinity, and are considered fairly representative of cutting operations on which reasonable care is taken to protect advance growth. Felling varied from light partial cuts to clear cutting and removed from 27 to 98% of the pulpwood volume. Material was taken to a 3-inch top, and no slash disposal was required.

Examinations of 125 one-tenth acre plots and 1,202 milacre quadrats on the 89 acres logged gave the following results: (See table on back of sheet for greater details).

1. The number of seedlings destroyed in the partial cuttings ran from 348 to 506 per acre, and stocking was lost on 74 to 130 of the milacres. Stocking, which before logging ran 28% to 46%, averaged 18% to 33% after cutting. Results were much the same for all methods and intensities of partial cut. The heaviest cuts, 16 cords per acre, appeared no more destructive than the lighter ones of 7 to 8 cords.

2. The clearcuttings showed a heavier loss of seedlings (57%), although the sample is smaller and the results were somewhat erratic. The loss in stocked quadrats, however, was only about 1/3; 29% of the quadrats remain stocked.

3. The same trend was apparent in the understory (trees 1.0 to 3.5 inches in d.b.h.), which included both growing saplings and suppressed old growth. Of the original 300 to 692 trees per acre 1/5 to 1/3 were lost, leaving from 215 to 469 trees per acre.

4. No significant differences in damage to reproduction were detected between horse and tractor (wheel type) skidding. A similar comparison of areas on which the farmer-operator did his own logging with those which were logged by hired labor also failed to show any consistent differences.

1/ Operated in cooperation with the Minnesota State Forest Service in Koochiching County, Minnesota.

October 1952

L. P. NEFF, Forester

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Logging Damage to Advance Growth in Big Falls Compartment Study

(Per acre)

Method of cutting	Cordwood volume removed	Reproduction: Trees: Before cutting	Reproduction: Trees: After cutting	Reproduction: Trees: Lost	Reproduction: Stocked Quadrats 1/: Before cutting	Reproduction: Stocked Quadrats 1/: After cutting	Reproduction: Stocked Quadrats 1/: Lost	Saplings 2/: Trees: Before cutting	Saplings 2/: Trees: After cutting	Saplings 2/: Trees: Lost
	Pct.	No.	No.	Pct.	No.	No.	Pct.	No.	No.	Pct.
Light partial cuts										
Tree selection	35	1,653	1,147	30	460	330	28	554	367	34
Group selection	29	972	624	36	280	176	37	350	270	23
Light cut from below	27	2,400	1,906	21	312	238	24	507	414	18
Weighted Average	30	1,582	1,134	28	363	255	30	476	352	26
Heavy partial cuts										
Shelterwood	57	1,423	1,087	24	307	230	25	300	215	28
Commercial clear cut										
Clear cutting	98	3,146	1,807	57	464	292	37	692	469	32

1/ Milacre quadrats: if a quadrat contained at least one established seedling or layer it was considered stocked.

2/ Trees 1-inch to 3.5 inches d.b.h.

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 382

Cubic Content of Sawlogs in Standing Trees

Most cubic-foot tables show volume for the entire stem including stump and tip, but occasionally foresters wish to know the volume of the merchantable bole only. Such information is given in the table below which shows the cubic-foot content inside bark of the sawlog portion of trees of different sizes. If the top utilization is governed by a minimum diameter of 8.0 inches inside bark, the table should apply to the average run of commercial timber in the Lake States for both hardwoods and conifers.

Diameter breast high (Inches)	Cubic feet inside bark in sawlog portion of stem when number of logs 1/ is						
	1	1½	2	2½	3	3½	4
10	7	9					
12	10	13	17				
14	13	17	22				
16	17	23	29	35	40		
18	22	29	37	44	50	56	61
20	27	36	45	54	62	70	76
22	33	43	54	64	75	83	91
24	39	52	65	77	89	99	109
26	46	60	76	91	105	117	127
28	54	70	88	106	121	136	147
30	61	80	102	122	140	157	169
35	83	112	139	167	190	213	230
40	109	146	183	218	245	278	305

1/ Merchantable height is measured above a 1-foot stump to a point on the stem where merchantability is limited by branches, defect, or deformity or a minimum top diameter of 8 inches inside bark.

October 1952

S. R. GEVORKIANTZ, Forester
L. P. OLSEN, Statistician

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TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 383

Power-Saw Girdling Saves Time in Timber Stand Improvement

Girdling of cull trees with a one-man power saw reduced actual time expended by nearly two-thirds and cash outlay by about one-half compared with axe girdling tests made on the Argonne Experimental Forest in second-growth hardwoods.

Girdling was done with a 30-pound one-man power saw. Using a kerf-tooth chain, it cut a kerf of about 0.55 inch. The operator held the saw blade against the tree and walked counter-clockwise until the tree was completely girdled through the cambium area. On fluted boles or ingrown bark, the end of the power saw was directed into the tree at right angles to normal cutting position.

In this study power-saw girdling was done on a 35-acre tract which contained 144 cull trees. Axe girdling was done on 146 cull trees in a nearby 40-acre tract. The total time including walking time for power-saw girdling was 5.42 man-hours or an average of 2.26 minutes per tree. Axe girdling, including walking, required 14.84 man-hours or 6.10 man-minutes per tree. The cost of labor expended per tree was 4.5 cents for the former as compared with 12.2 cents for axe girdling. Power-saw rental amounted to around 0.75 cents per tree bringing average girdling cost per tree to 5.25 cents. If it were done as an integral part of the logging operation, the cost per tree would be only about 3 or 4 cents.

One and one-half years after treatment, none of the clean, complete girdles had healed over, and often the cambium had died back one-half to one inch from the girdle. A double girdle about an inch or two apart is suggested for species which show strong bridging-over tendencies.

The net operating time for girdling operations only, excluding walking time, is given in the table below in terms of man-minutes.

D.B.H. (Inches)	Power saw	Axe girdling	D.B.H. (Inches)	Power saw	Axe girdling
	Minutes	Minutes		Minutes	Minutes
6	.20	.58	22	1.14	3.13
8	.26	.72	24	1.41	3.86
10	.32	.88	26	1.70	4.66
12	.39	1.07	28	2.02	5.91
14	.47	1.30	30	2.37	6.93
16	.58	1.56	32	--	7.73
18	.74	1.83	34	--	8.58
20	.93	2.45			

October 1952

J. H. STOCKFELDER, Forester
C. ARBOGAST, Forester

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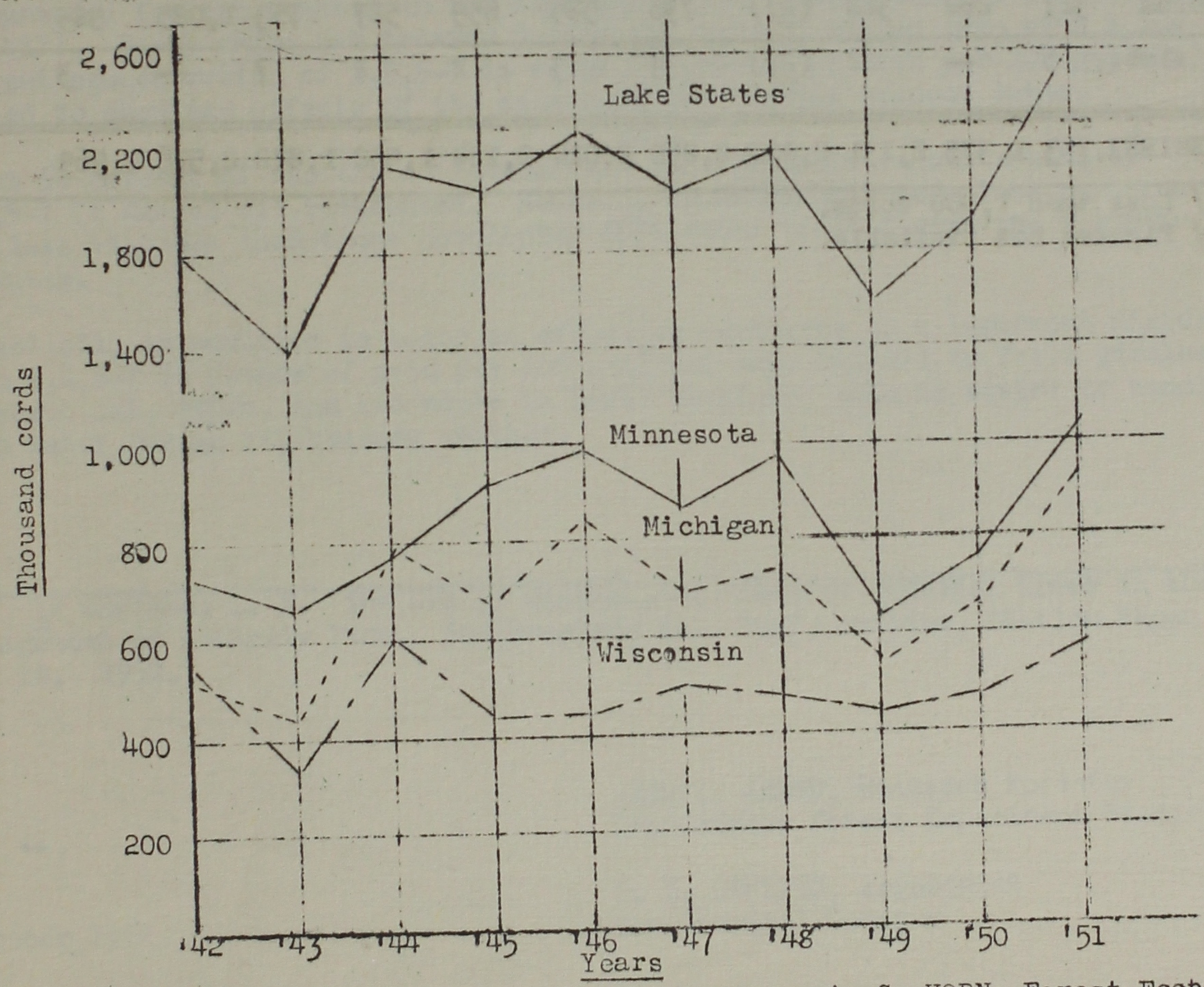
TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 384

Ten Years' Pulpwood Production in the Lake States (1942-1951)

An average of nearly 2 million cords of pulpwood has been cut annually in the Lake States during the period 1942 to 1951. During this period production has shown a general upward trend and reached an all-time high of over 2½ million cords in 1951. The addition of several new mills and the enlarged daily capacity of existing mills in the region has increased demands for wood. Minnesota has produced 42 percent of the average total output; Michigan, 34 percent; and Wisconsin, 24 percent.

Some important changes in species used have taken place during the past decade. Aspen, which ranked fourth as a pulpwood species at the beginning of the period now is the principal pulpwood species cut in the Lake States (see table back of sheet). Pine, spruce, and balsam fir now rank number 2, 3, and 4, respectively. Hemlock, once the principal pulpwood species in the region, has fallen to fifth in importance. Miscellaneous hardwoods production, although still small, has increased nearly 1,800 percent from 1942 to 1951.



October 1952

A. G. HORN, Forest Economist

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Annual Pulpwood Production in the Lake States by Species

1942 - 1951

(Thousand standard cords, rough-wood basis)

Species	Annual production										
	'42	'43	'44	'45	'46	'47	'48	'49	'50	'51	Average
Pine	356	292	484	—	493	510	493	273	345	544	421
Spruce	426	311	472	—	416	389	437	319	316	420	390
Balsam	257	215	344	--	258	312	401	319	318	348	308
Tamarack	15	13	20	--	24	26	10	4	2	19	15
Cedar	1	--	2	--	—	—	—	(1/)	(1/)	(1/)	(1/)
Hemlock	365	282	419	--	314	199	182	108	131	220	247
Softwoods	1,421	1,113	1,741	(2/)	1,505	1,436	1,523	1,023	1,112	1,551	1,381
Aspen	322	258	380	--	714	562	625	486	694	935	553
Misc. hdwds.	5	4	8	—	22	23	34	41	59	90	32
Hardwoods	327	262	388	(2/)	736	585	659	527	753	1,025	585
Waste, slabs, etc.	5	--	2	(2/)	9	3	2	2	7	—	3
ALL SPECIES	1,753	1,375	2,131	2,000	2,250	2,024	2,184	1,552	1,872	2,576	1,969

1/ Less than 1,000 cords.
2/ Figures not available.

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 385

Frill Girdle Tests With 2,4,5-T in Lower Michigan

Scrub oak, aspen, and red maple can be controlled by applying a low concentration of 2,4,5-T ester in diesel oil to frill girdles according to tests made by the Station during 1951 on the Lower Michigan National Forest in connection with plantation release studies. In these tests, frill girdles (one continuous bark cut around the tree) were made on scrub oak (includes white, red, and northern pin oaks), aspen, and red maple at different seasons of the year, and 2,4,5-T ester concentrations, ranging from 1 to 10 percent by volume (4 to 40 pounds per 100 gallons), were applied in both water and diesel oil carriers.

All trees treated with the oil carrier had dead tops by the end of the first growing season regardless of the concentration of 2,4,5-T ester and season of the year it was applied. Trees treated with the water carrier reacted differently depending on the concentration of the 2,4,5-T and season of the year applied. A 2-percent concentration of 2,4,5-T ester in water (the treatment recommended for oak control in the Southeast[1]) did not produce a satisfactory top kill. Scrub white oak treated during the dormant season even with a 10-percent concentration of 2,4,5-T in water (40 pounds of acid per 100 gallons) failed to show any effects of the treatment two growing seasons later.

About 50 percent of the trees treated with the 1-percent concentration of 2,4,5-T in diesel oil resprouted. However, these sprouts were less numerous and less vigorous than those developing from trees treated with the 2,4,5-T in water.

Diesel oil, in addition to being an effective herbicide in a 1-percent mixture with 2,4,5-T (4 pounds of acid per 100 gallons) when applied to frill girdles on scrub oak, aspen, and red maple in Lower Michigan, also is easier to handle than water during subfreezing weather.

1/ Chaiken, L. E. The Use of Chemicals to Control Inferior Trees in the Management of Loblolly Pine. Southeastern For. Expt. Station, Station Paper No. 10. 1951.

JOHN L. AREND, Research Forester
Lake States Forest Experiment Station

L. L. COULTER, Agronomist
Dow Chemical Company

October 1952

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LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA
No. 386

Results of Improvement Cutting in Second-Growth Northern Hardwoods in Upper Michigan

That it is practicable to make light improvement cuts in second-growth northern hardwoods is indicated by 5-year records from the 40-acre "farm woodlot" on the Upper Peninsula Experimental Forest near Dukes, Michigan.

In 1946 a stand of second-growth hardwoods originating from a commercial clear cutting 35 years earlier, and overtopped by the usual number of old decadent logging remnants, was selected for woodlot management. This area was divided into 5 eight-acre compartments, each of which received a light improvement cut once during the next five years. The following table shows the yields and growth for the unit.

Stand, cutting, and growth	Period	Volume per acre			Trees per acre	
		Cubic volume	Basal area	Sawlog volume (gross)	Trees 5" d.b.h. and over	Trees 10" d.b.h. and over
	Year	Cu.ft.	Sq.ft.	Bd.ft.	Number	Number
Original stand	1946	2,866	103	5,628	222	64
Removed in cuttings	1946-50	431	14	1,077	17	11
Present stand	1950	2,775	100	5,183	218	60
Average annual growth	1946-50	68	2.2	126	-	-
Average annual growth on check area	1946-50	69	2.0	146	-	-

The annual growth of 68 cubic feet in trees 5 inches d.b.h. and larger is approximately one cord per acre per year of cordwood or pulpwood. Gross board-foot increment of 126 board feet per acre per year was in trees 10 inches d.b.h. and larger.

The average annual cut per acre in products was 2.58 cords chemical wood, 1 cord pulpwood, and 343 board feet of sawlogs. The value of this timber averaged $38.00 per acre after deducting skidding and hauling costs. About 30 man hours were required per acre for cutting. These returns indicate that for areas where hardwood pulpwood or cordwood markets exist, extensive cultural operations on similar second-growth stands are possible at only a very nominal outlay of labor by the owner.

It is apparent from the above table that the light cutting did not affect the rate of growth or appreciably change the stand structure. However, poor quality and poor risk trees were removed in the cuttings so that the growth was put on the better quality trees; this is the primary objective in all improvement cuttings. The removal of some additional low-value trees would undoubtedly have been economically feasible and silviculturally desirable.

F. R. LONGWOOD, Research Forester

January 1953
MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 387

Deer Damage to a Jack Pine Plantation in Michigan

Deer damage to planted and natural jack pine seedlings has been observed in the Lower Peninsula of Michigan for several years, but actual measurements of such damage have not been generally available. Reported here are data gathered in Alcona County, Michigan, on the Lower Michigan National Forest.

In 1949 a deer proof exclosure (40 x 40 feet)[1] was constructed in a jack pine plantation in which 2-0 stock had been set out in the fall of 1947 and replanted with similar stock in the fall of 1948 because of heavy deer damage. Half of the exclosure was rabbit-proofed in 1950, and so far no rabbit damage has occurred. In 1949 and again in 1951 all jack pine seedlings in the exclosure and in a comparable unprotected plot adjacent to it were counted and measured for height with the results shown below:

Conditions and kind of seedlings	Jack Pine Seedlings					
	On 1600 sq. ft.		Average height		Total live stem length	
	1949	1951	1949	1951	1949	1951
	Number		Feet		Feet	
Protected						
Planted	26	26	0.7	1.9	17.8	49.5
Natural	7	10	1.5	2.4	10.7	24.4
Unprotected						
Planted	16	11	0.6	0.9	9.3	10.2
Natural	22	17	1.2	1.1	25.8	18.6

These results show that the protected seedlings suffered no mortality and the total height of all trees increased from 128 to 178 percent in two years. The unprotected seedlings suffered from 23 to 31 percent in mortality and had a lower height growth. In fact the total height of all the natural seedlings had 28 percent less growth in 1951 than in 1949. All mortality and height reduction was attributable to deer browsing.

These data illustrate the need for deer herd control if satisfactory jack pine regeneration is desired.

1/ See Technical Note No. 361 for specifications.

LAURITS W. KREFTING, Biologist

January 1953

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES
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UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 388

Some Effects of Spacing on Jack Pine Development after 25 Years

Twenty five years after planting, jack pine seedlings set out at a spacing of 6x6 feet have developed more satisfactorily than others planted at spacings of 4x4 and 8x8 feet in a test established as an administrative study on the Huron National Forest on a site fairly representative of the poorer, sandy planting "chances" on the outwash plains of northern Lower Michigan.

In the spring of 1925, 1-0 jack pine seedlings were planted in furrows by the bar-slit method at three spacings - 4x4, 6x6, and 8x8 feet - in three 1-acre square plots laid out side by side on a level area of Grayling sand occupied by an open stand of scrubby northern pin oak. Preplanting release was not necessary but all overtopping oaks were cut in 1939. Fail spots were replanted in 1926 and 1927. A summary of measurements taken in 1936 and 1951, which show several differences in growth attributable to spacing, is listed below.

Stand Development 1925-1951

Average spacing between trees			Stems per acre			Avg. d.b.h.	Basal area	Volume 1/		Average height	
1925	1936	1951	1925	1936	1951	1951				1936	1951
Ft.	Ft.	Ft.	No.	No.	No.	In.	Sq.ft.	Cu.ft.	Cords	Ft.	Ft.
4x4	5x5	5x6	2,722	1,620	1,500	3.1	73	800	3.9	7.4	25.7
6x6	7x8	8x8	1,210	780	730	4.1	67	740	7.8	7.5	25.6
8x8	10x10	10x11	681	425	390	4.6	45	540	5.4	7.8	25.2

1/ Main stem unpeeled cubic-foot volume of all trees and standard cords of rough wood to a 3-inch top d.i.b. from trees 4 inches d.b.h. and up.

The jack pine seedlings planted at the 6x6-foot spacing have grown the best and are about ready, both silviculturally and economically, for a light post or pulpwood thinning. Seedlings originally spaced 4x4 feet occupy the site fully, but the trees are too small to be thinned commercially. On the other hand, the seedlings planted at a spacing of 8x8 feet have developed orchard-like crowns and probably will not produce maximum yields at maturity.

January 1953

R. A. RALSTON, Forester

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LAKE STATES FOREST EXPERIMENT STATION
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No. 389

Comparative Height Growth of Native Conifers in Northeastern Minnesota

How much the juvenile growth rate of common Lake States conifers varies by species, even on the same site, is illustrated by a study made on the Kawishiwi Experimental Forest in northeastern Minnesota.

In May 1937, 150 trees each of six species were planted with mattocks on an upland rocky site using 2-0 stock produced from indigenous seed in a small local nursery. Trees of each species were planted at a 4x4-foot spacing on subplots of 25 trees each.

A complete check of the plantation made in 1940 and again when the stand was 10 years old gave the following results:

Species	Total height 1/			
	Average			Maximum
	1937	1940	1947	1947
	Feet	Feet	Feet	Feet
White spruce	0.3	1.4	6.0	9.5
Black spruce	0.4	1.9	7.7	12.5
Red pine	0.3	2.0	8.7	12.0
White pine	0.4	2.1	8.7	14.0
Jack pine	0.8	4.0	15.1	19.0
Tamarack	0.9	4.6	15.0	22.0

1/ At end of growing season.

The fastest growing species were jack pine and tamarack, with no significant difference between them. The spruces made the poorest growth, although black spruce grew appreciably faster than did white spruce. White pine and red pine grew at an equal rate, both showing better than the spruces.

Knowledge of the juvenile growth rate of several species on a site suitable for several of them can help planters decide which species to choose. Such information also provides clues as to the number of early releases which may be necessary.

January 1953

EUGENE I. ROE, Research Forester

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM No. 390 ST. PAUL 1, MINNESOTA

Volume in Tops and Limbs of Sawlog Trees

Sawlog trees commonly contain appreciable volumes of pulpwood or other useful products above the sawlog portion of the stem, but available volume tables do not account for this additional wood. With increasingly intensive utilization, foresters in the Lake States must be able to estimate the amount of all usable wood in the tree. To help them do so the Station has prepared two tables which show the volume of tops and limbwood in unpeeled cords per M board feet of sawlog material. These tables take into account the fact that top wood factors per M board feet are different for softwoods and hardwoods, and vary by merchantable height, but are not appreciably affected by tree diameters.

The following simplified table has been prepared for use when height data are available only for the sawlog portion of the stem or when factors are needed for rather large areas with somewhat mixed conditions.

Factors for estimating top and limbwood volume per M bd.ft.
International 1/4-inch Rule

Merchantable height 1/ 16-foot logs (number)	Additional utilization above sawlogs 2/		Remaining top and limbwood of hardwoods 3/
	Conifers and aspen	Hardwoods (except aspen)	
	Cords 4/	Cords 4/	Cords 4/
1	1.37	1.00	1.25
1½	.71	.53	1.08
2	.41	.31	.83
2½	.25	.16	.58
3	.14	.09	.44
3½	.08	.04	.36
4	.03	0	.32

1/ Usable height above a 1-foot stump. Minimum top not less than 8 inches d.i.b.

2/ Additional utilizable material above sawlogs consists of pulpwood or similar material in lengths not less than 4 feet and diameters not less than 4 inches d.i.b.

3/ Remaining top of the stem (not suitable for pulpwood but of value for fuelwood) and hardwood limbs both to a diameter not less than 4 inches d.i.b.

4/ Standard cords of closely piled rough wood containing 80 cubic feet of peeled wood. Similar factors for application to Scribner volumes may be obtained by multiplying the above values by the figures in the last column of the table on the reverse of this sheet.

On back of this sheet appears a more detailed table to be used when total height and the usable height above the sawlog portion of the stem are known.

CLARENCE D. CHASE, Forester
S. R. GEVORKIANTZ, Forester

January 1953
MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Converting factors for computing utilizable[1] volume in upper stem of sawlog trees

16-foot sawlogs (number)	8-foot bolts in upper stem 2/	Additional volume per M bd.ft. (International 1/4-inch rule) when total height is 50'	60'	70'	80'	90'	100'	Multiplier for conversion to Scribner rule
	Number	Cubic feet 3/						
1	1	54	67	69	73	-	-	1.22
	2	84	112	124	136	-	-	
	3	99	141	167	184	-	-	
1½	1	21	34	43	50	55	-	1.18
	2	31	53	75	89	97	-	
	3	-	64	92	115	130	-	
2	1	-	17	26	34	41	-	1.12
	2	-	23	43	57	71	-	
	3	-	-	52	71	90	-	
2½	1	-	-	11	20	30	32	1.10
	2	-	-	18	32	48	57	
	3	-	-	23	40	63	77	
3	1	-	-	-	10	18	24	1.09
	2	-	-	-	17	32	44	
	3	-	-	-	22	40	60	
3½	1	-	-	-	5	13	20	1.07
	2	-	-	-	7	19	31	
	3	-	-	-	-	23	39	
4	1	-	-	-	-	4	13	1.06
	2	-	-	-	-	7	22	
	3	-	-	-	-	-	27	

1/ Volume between flexible 8-inch d.i.b. top of sawlogs and flexible 4-inch d.i.b. top of bolts merchantable as pulpwood or its equivalent.

2/ Average number of bolts of additional utilizable material above sawlogs.

3/ Divide these values by 80 to obtain unpeeled cords per M board foot International 1/4-inch rule. Multiply them by figures in the right hand column to convert to Scribner basis.

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No. 391

Time Required to Prune Red Pine to Various Heights

It may be better to prune plantation-grown red pine to produce clear 12-foot rather than 16-foot butt logs, according to recent time studies made in Lower Michigan. The average cost in labor time per lineal foot for pruning that section of the bole between 12.5 and 17 feet was 70 to 80 percent greater than that for the lowest 12.5 feet. Thus, it might prove a better investment to prune more acres of crop trees to 12.5 feet rather than fewer to 17 feet.

In the fall of 1950, from 20 to 100 crop trees in each of five red pine (*Pinus resinosa*) plantations, ranging in age from 25 to 35 years old, were pruned to heights of 8.5, 12.5, and 17 feet. The trees are spaced at about 6x8 feet and are growing about one foot in height per year. At the time of pruning the trees averaged from 30 to 40 feet tall and from 5 to 8 inches in diameter breast high. A sectional aluminum alloy pole-saw with a 15-inch curved blade was used by semi-skilled workers.

The total time required to prune various sections of the tree and the time per lineal foot of pruned stem are presented in the following table:

Height pruned	Pruned length	Total time	Time per lineal foot
Feet	Feet	Minutes	Minutes
8.5	8.5	3.0-3.5	.35-.41
8.5-12.5	4.0	2.5-3.0	.62-.75
12.5	12.5	5.5-6.5	.44-.52
12.5-17.0	4.5	3.5-4.0	.78-.89
17.0	17.0	9.0-10.5	.53-.63

Possible reasons for the increase in time per lineal foot to prune the 12.5-17.0 foot section are: (1) pole-saw pruning becomes less efficient at greater heights (a short light-weight ladder might prove more effective for heights over 12.5 feet): (2) this part of the crown contains more live branches, which are harder to cut than dead ones; and (3) the largest limbs in red pines of this stage of development are in this section.

April 1953 (Revised April 1954)

R. A. RALSTON, Forester

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

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No. 392

Effects of Competition on Red Pine and White Pine Reproduction

Competition from brush and the presence of a heavy overstory seriously retard the growth and abundance of red pine seedlings, while under the same conditions white pine seedlings often continue to grow and increase, according to observations made in two 140-year-old red pine-white pine stands on the Chippewa National Forest. One was comparatively free of brush, and was cut from a basal area of 145 square feet per acre (141 stems) to 98 square feet per acre (87 stems) in 1944. The second stand had brush on 34 percent of the quadrats, and was cut from a basal area of 184 square feet (150 stems) to one of 124 square feet (98 stems) in 1944. The number of pine seedlings present in 1944 and 1952 varied as shown in the graph on back of this sheet.

Similarly, the percentage of quadrats stocked with each species of pine reproduction varied with the amount of brush cover and the density of the parent stand.

Percent of Quadrats Stocked with Reproduction

	Stand Number 1		Stand Number 2	
	1944	1952	1944	1952
Red pine	55.0	70.0	14.0	10.0
White pine	70.0	72.5	78.0	90.0

Mature red pine stands with white pine in mixture often have a well stocked understory of white pine seedlings. On all but the best sites foresters usually would prefer to have red pine. But if red pine reproduction is desired in the understory, attention must be given not only to low competition by brush, but also to the density of the overstory. The test plots in this study show that mixed red pine-white pine stands over 120 years old should be reduced below 90 square feet of basal area in order to favor red pine reproduction.

April 1953

DAVID F. CONOVER, Research Forester

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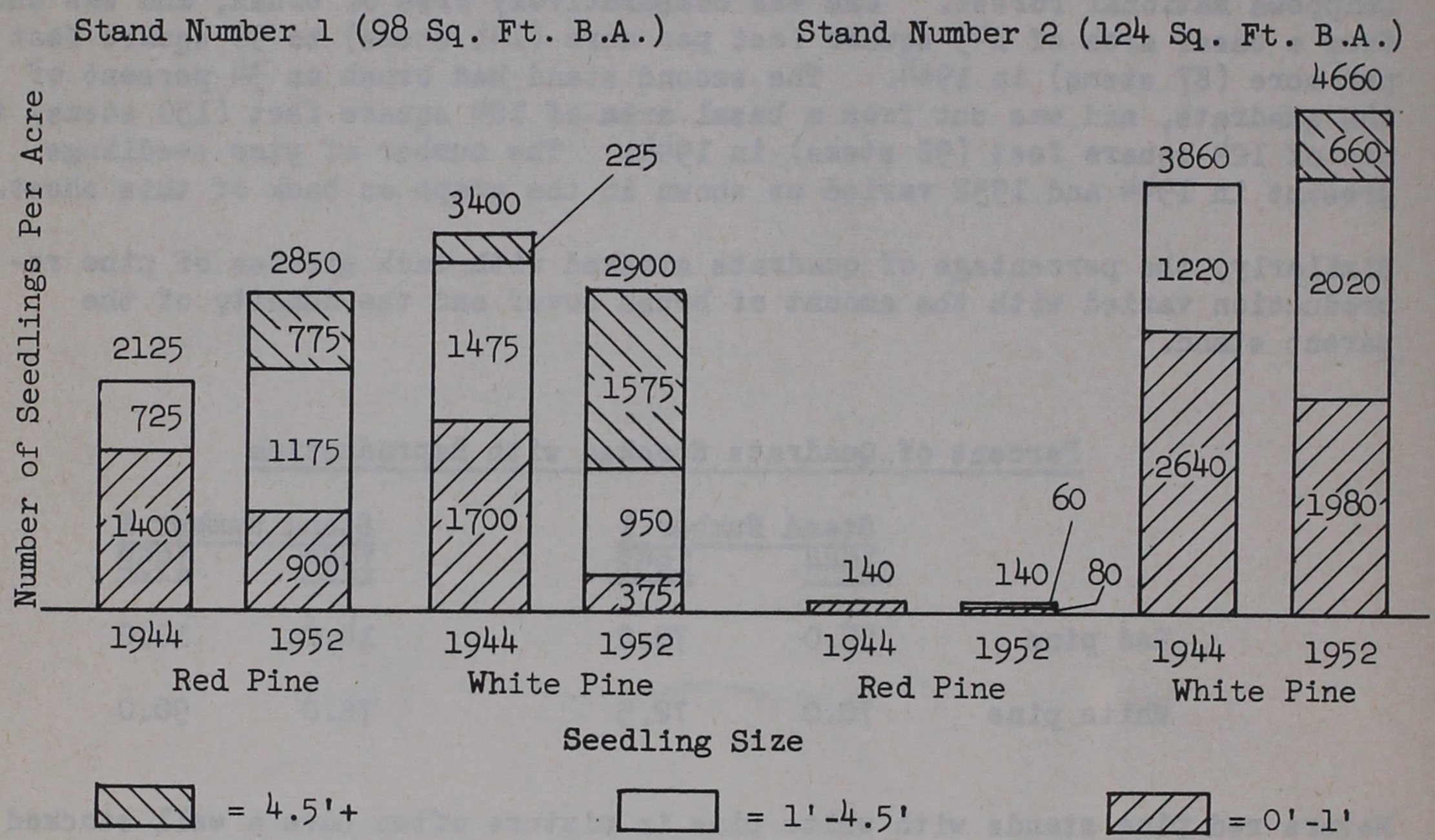
Stand Number 1 (98 Sq. Ft. B.A.)
Stand Number 2 (124 Sq. Ft. B.A.)
Number of Seedlings Per Acre
2125
725
1400
2850
775
1175
900
3400
225
1475
1700
2900
1575
950
375
140
140
60
80
3860
1220
2640
4660
660
2020
1980
1944
1952
Red Pine
1944
1952
White Pine
1944
1952
Red Pine
1944
1952
White Pine
Seedling Size
= 4.5'+
= 1'-4.5'
= 0'-1'

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No. 393

1952 Forest Tree Seed Crop Fair in Lake States

Forest trees in the Lake States produced seed crops in 1952 about equal in the aggregate to those of 1951 but poorer than those of 1950, according to observations made at field branches of the Lake States Forest Experiment Station. The native pines, most used in reforestation, generally had poor crops. The spruces were a little better. Other conifers mostly produced fair to good seed crops. For the hardwood species, seed crops in general ran in this manner: maples, generally good; ashes, failure to poor; most other species, poor to good; with basswood and black cherry in northern Wisconsin producing the only bumper crops (see table on back of sheet).

In northern Minnesota the only species producing good seed crops were balsam fir, northern white-cedar, sugar maple, yellow birch, and (in northeastern Minnesota only) white spruce and quaking aspen. Failures were reported for red pine, eastern white pine, basswood and black ash. Other species had poor to fair crops.

In northern Wisconsin bumper crops were reported for basswood and black cherry, good crops for jack pine (northwest), Scotch pine, black spruce, balsam fir (northwest), eastern hemlock, northern white-cedar, sugar maple, red maple, quaking aspen, bigtooth aspen, and northern red oak. All other species were reported poor to fair, except paper birch, white ash, and black ash which were failures.

In central Upper Michigan the only species to produce good crops were northern white-cedar, red maple, yellow birch and American elm. Others were poor to fair.

In the Lower Peninsula of Michigan the only species with a good seed crop report was red maple. All other species reported upon produced poor to fair crops.

Generally speaking, 1952 was a poor year in the Lake States for seed collectors, who are interested mostly in the pines and spruces. It produced no better than fair prospects for establishing natural reproduction and for maintenance of seed-eating wildlife species.

April 1953

PAUL O. RUDOLF, Forester

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Table 1.—Forest tree seed crop reports in the Lake States, 1952

Species	Estimated percentage of a full crop[1] in —			
	Northern Minnesota	Northern Wisconsin	Central Upper Michigan	Lower Peninsula Michigan
Red pine	7-25	25	25	50
Eastern white pine	7-25	25	2/-	50
Jack pine	50	50-75	-	-
Scotch pine	-	75	-	-
White spruce	50-75	25-50	25	25
Black spruce	50	75	25	25
Norway spruce	-	25	-	-
Balsam fir	75	50-75	25	25
Eastern hemlock	-	75	50	-
Northern white-cedar	75	75	75	50
Tamarack	-	25	-	-
Sugar maple	75	75	50	-
Red maple	-	75	75	75
American beech	-	-	50	3/25
Basswood	7	95	-	-
Yellow birch	75	25	75	-
Paper birch	25-50	7	-	-
Quaking aspen	25-75	75	-	-
Bigtooth aspen	-	75	-	-
American elm	-	-	75	3/25
White ash	-	7	-	-
Black ash	7	7	25	-
Northern red oak	-	4/75	-	25
White oak	-	5/ -	-	3/25-6/50
Black cherry	-	95	-	-

1/ Percentages of full crop are classified as follows: 0-15, failure; 16-35, poor; 36-60, medium; 61-90, good; and 91-100, bumper.
2/ (-) signifies no report on this species.
3/ North 1/2 Lower Peninsula.
4/ A 75-percent crop was also reported for western Wisconsin.
5/ A 25-percent crop was reported for southwestern Wisconsin.
6/ South 1/2 Lower Peninsula.

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No. 394

Jack Pine Growth Rates in Minnesota

A knowledge of diameter and volume growth is necessary in management planning and in the estimation of future yields of timber stands. Such information is provided by the following values based upon measurements of 1,960 trees made during the course of the Forest Survey in the Central Pine District of Minnesota (Aitkin, Beltrami, Cass, Clearwater, Crow Wing, Hubbard, Itasca, and Wadena counties). No allowance has been made in the gross growth table for mortality or cull losses. Local correction factors for these items should be developed and applied.

10-Year Diameter Growth and Annual Gross Growth Percent of Jack Pine in the Central Pine District, Minnesota

Present diameter class (inches)	Stand size and stocking class								
	Restocking (0-5")			Pole timber (5-9")			Saw timber (9"+)		
	Good (70+)	Medium (40-69)	Poor (10-39)	Good (70+)	Medium (40-69)	Poor (10-39)	Good (70+)	Medium (40-69)	Poor (10-39)
	Average diameter growth in 10 years - inches								
4	1.6	1.9	2.1	.8	1.1	1.5	.7	.9	1.0
6	1.7	1.9	2.0	.9	1.2	1.6	.8	1.0	1.2
8	1.7	1.9	2.0	1.0	1.3	1.7	1.0	1.1	1.3
10	1.8	1.9	1.9	1.1	1.4	1.8	1.0	1.2	1.4
12	1.8	1.9	1.9	1.2	1.5	1.8	1.1	1.3	1.5
14	1.8	1.9	1.9	1.2	1.5	1.8	1.2	1.3	1.5
16	1.8	1.8	1.9	1.2	1.5	1.8	1.2	1.3	1.5
	Annual gross growth percent[1/] - cordwood volume								
4	.120	.132	.116	.054	.080	.099	.036	.059	.105
6	.138	.155	.175	.070	.095	.129	.062	.079	.095
8	.074	.084	.089	.042	.055	.074	.042	.046	.055
10	.050	.053	.053	.029	.038	.050	.026	.032	.038
12	.033	.036	.036	.021	.027	.033	.019	.023	.027
14	.023	.025	.025	.015	.019	.023	.015	.016	.019
16	.020	.020	.021	.013	.016	.020	.013	.014	.016

1/ Except in 4-inch trees, to be applied to present volume per acre in rough cords to get annual growth in rough cords. In 4-inch trees to be applied to number of trees on a 1/50 acre plot to get net annual ingrowth in rough cords per acre.

April 1953

PAUL C. GUILKEY, Forester

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No. 395

Lupines as a Nursery Soil Improvement Crop

Lupines have been used as a soil improving crop for many years in Europe, both in forest nurseries and in field plantations, but only recently have they been used in nurseries in the United States. Several lots of lupine, furnished through the cooperation of the West German Ministry of Food, Agriculture, and Forestry, and the Bavarian Forestry Administration, showed good promise on a sandy, rather acid soil at Hugo Sauer Nursery, Rhinelander, Wisconsin in 1951. All are annuals except one.

The seed was sown on June 13, 1951 in drills 9 inches apart and given normal nursery care. Half of the plots were fertilized with dolomitic limestone at the rate of 1,000 pounds per acre. Observations made in September 1951 are given in the table below.

Lupine species	Scientific name	Average height		Over-dry weight produced per acre		Nitrogen in entire crop per acre	
		Unlimed	Limed	Unlimed	Limed	Unlimed	Limed
		Inches	Inches	Pounds	Pounds	Pounds	Pounds
Perennial	*Lupinus perennis*	11	10	5,160	6,890	77	103
Blue bitter	*L. angustifolius*	28	33	4,260	6,510	66	102
White flat bitter	*L. albus*	40	39	5,310	5,575	80	84
Italian bitter	*L. albus* var. *permes*	28	24	2,690	3,220	39	47
Weiko sweet yellow	*L. luteus*, sweet variety	23	27	5,450	5,570	82	84

Bye, used for comparison with the lupines, produced only 1,550 pounds of oven-dry material per acre and its nitrogen production was only 34 pounds per acre.

Follow-up tests of several lots in 1952 in 8 nurseries brought out the superiority of blue bitter lupine over the white annual, and especially good adaptability of blue lupine in colder areas of the Lake States and higher altitude nurseries in Montana and California. At Rhinelander, Wisconsin, for example, the blue bitter lupine in 1951 withstood temperatures of 26° F., was pest free, and produced excellent nodules on the roots. In the Montana Nursery, production of air-dry material amounted to 6 tons and 3 tons respectively for the blue and the white annual lupines. In the 1952 tests these two lupines did poorly in nurseries located in areas with warm or hot summers, but very early seedings may be the solution here.

Based on results to date, special care should be taken to treat each new seeding with lupine nitrogen inoculum and where fertility is low, add at least 500 pounds per acre of 0-10-20 fertilizer or its approximate equivalent. Liming appears to increase growth on strongly acid soils.

APRIL 1953

J. H. STOECKELER, Forester

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No. 396

The Jack-Pine Budworm in Michigan

The jack-pine budworm (Choristoneura sp.), which occurred in outbreak numbers in localized areas of Michigan from 1949 through 1951, continued to defoliate jack pine on the Huron National Forest and adjacent state forests in the Lower Peninsula in 1952. Budworm populations on the Hiawatha National Forest in the Upper Peninsula declined and there was little defoliation.

Substantial tree mortality associated with the budworm was observed on the Huron National Forest in the survey made after the 1951 defoliation period (see Technical Note No. 376). Mortality in some tree classes was so critical that forest managers were alerted to the menace.

To determine whether additional losses had occurred after the budworm defoliation period in 1952, the infested area was resurveyed in cooperation with the Forest Service. The plan of survey was similar to that designed in 1951 to produce results statistically accurate to 8 percent of the total volume on the 109,000 acres of jack-pine type within the forest boundaries.

Budworm defoliation was light during 1952 on the 42 fifth-acre study plots included in the survey. Losses in jack-pine stands infested with budworms in 1952 were essentially the same as in 1951 (see table).

Mortality Per Acre of Jack Pine Infested With Budworms

Tree size class	1951			1952		
	Number of trees killed		Percent of stand	Number of trees killed		Percent of stand
	Average	Range		Average	Range	
Poles 1/	0.2	0- 0.7	3	0.3	0.1- 0.8	3
4-inch saplings	10	0- 18	8	10	0 - 17	10
2-inch saplings	71	20-180	33	31	7 -105	22
Reproduction	30	2- 62	14	23	0 - 40	8

1/ Data for poles represent loss in cords rather than number of trees.

Again no correlation was apparent between the severity of budworm defoliation after three seasons and the mortality among poles, saplings, and reproduction. Little additional mortality is predicted if the budworm continues to decline in 1953. If severe defoliation recurs, however, it will result in increased losses in the smaller size classes and top killing among merchantable trees.

In areas of the most severe budworm defoliation continued encouragement of salvage cutting, and removal of suppressed and orchard-type jack pine are recommended. Surveys to follow the course of the outbreak will be conducted in 1953.

DANIEL M. BENJAMIN, Entomologist
U.S. Bureau of Ent. and Plant Quarantine

April 1953

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No. 397

Resurgence of Tamarack in Minnesota

Recent forest surveys are showing that Minnesota tamarack has recovered in large measure from the severe setback it received between 1910 and 1930 from the sawfly epidemic, high water levels, and possibly other causes. If not too severely damaged again by insects or other enemies, and if encouraged by proper cutting, this species may yield some very substantial quantities of pulpwood fence posts, and mine timbers during the next ten years.

Significant Facts on Minnesota Tamarack

	1936	Now 1/
Type acreage	657,000	(2/)
Size class proportions		
Pole timber 3/	23.4 pct.	52.1 pct.
Seedling-sapling	44.9 "	39.7 "
Poorly stocked	31.7 "	8.2 "
	100.0 pct.	100.0 pct.
Average volume per acre (cords)	2.3	6.3
Average annual growth per acre (cords)	.135	.29
Average allowable annual cut per acre (cords)	.084	.16

1/ Based on surveys covering half of the 1936 area.
2/ Assumed to be the same.
3/ Includes insignificant area of sawtimber.

Minnesota surveys which to date have covered half of the supposed 657,000 acres of tamarack in this state, indicate that most of the land is fairly well stocked. Only 8 percent of the area recently surveyed was called poorly stocked, whereas 32 percent was so classified in 1936. Evidently some 150,000 acres have reseeded naturally and are now in the seedling and sapling category.

At the same time, nearly two-thirds of the former seedling and sapling area has now advanced to the small pole stage, that is, it is approaching the size where it can be harvested for pulp or posts. (See county statistics on reverse side.)

Judging by surveys so far completed, the tamarack type in Minnesota should soon be able to support a sustained annual cut of 90,000 to 100,000 cords, approximately twice the actual cut in 1950.

R. N. CUNNINGHAM, Forest Economist
VIRGIL FINDELL, Forester, I.R.R. & R.

April 1953

MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

Tamarack in Minnesota

AREA, VOLUME, GROWTH, AND ALLOWABLE CUT SHOWN BY RECENT SURVEYS

County	Area tamarack type	Volume of species	Average annual growth	Allowable annual cut
	Acres	M cords	M cords	M cords
Aitkin.....	39,400	215.0	13.5	6.7
Beltrami.....	64,400	359.6	17.7	7.4
Cass.....	39,100	306.6	12.0	6.6
Clearwater.....	9,100	124.0	2.6	2.7
Crow Wing.....	10,400	49.4	2.1	1.7
Hubbard.....	3,900	30.0	2.1	.6
Itasca.....	38,600	232.6	17.9	8.9
Wadena.....	1,500	4.7	.5	.1
Group I total..	206,400	1,321.9	68.4	34.7
Carlton.....	3,500	18.4	2.2	0.7
Pine.....	5,300	16.3	1.3	.4
Group II total.	8,800	34.7	3.5	1.1
Lake-of-the-Woods	37,600	275.6	15.4	4.7
Black River.....	13,900	75.9	*	1.4
Big Falls.....	33,400	217.1	*	7.3
Red River Valley.	21,000	91.9	5.4	1.8
Group III total	105,900	660.5	20.8	15.2
Total 3 Groups...	321,100	2,017.1	92.7	51.0

* Not estimated.

AREAS BY SIZE CLASSES

Group	Total	Pole timber 1/	Seedling and Sapling	Poorly stocked
		Acres		
Group I	206,400	114,100	76,400	15,900
Group II.....	8,800	3,500	3,400	1,900
Group III.....	105,900	49,700	47,600	8,600
Total 3 Groups...	321,100	167,300	127,400	26,400

1/ Includes insignificant area of sawtimber.

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 398

1951 Lake States Pulpwood Production Reaches All Time High

1951 Lake States pulpwood production amounted to 2,577,000 cords in the largest annual cut in the history of the region. The pulpwood harvest in 1951 was 15 percent more than in 1946, the previous record year.

Following the pattern of other years, Minnesota continued to be the largest pulpwood producing state in the region, accounting for 42 percent of the total regional cut, as compared to 36 percent for Michigan and 22 percent for Wisconsin.

Percentagewise - tamarack, birch, hemlock and pine showed the biggest increases from the previous year. Aspen, spruce and balsam fir increases were only moderate.

Wood imported from the western states and Canada was up considerably from 1950. Western wood increased from 65,000 cords in 1950 to 139,000 cords in 1951, a 114 percent increase. Canadian wood followed a similar pattern, increasing from 490,000 cords in 1950 to 842,000 cords in 1951.

Production and Imports of Pulpwood, Lake States - 1951

Species and destination	Production by States 1/				Imports			Total receipts
	Minn.	Wis.	Mich.	Region	U.S. 2/	Canada	Total	
	Standard Cords (rough wood basis)							
Aspen								
Minn. mills	227,393	10,850	--	238,243	--	57,455	57,455	295,698
Wis. "	55,664	270,194	220,252	546,110	66	23,112	23,178	569,288
Mich. "	--	--	105,366	105,366	--	20,893	20,893	126,259
Other " 3/	--	--	45,570	45,570	--	--	--	--
Total	283,057	281,044	371,188	935,289	66	101,460	101,526	991,245
Balsam fir								
Minn. mills	72,615	--	--	72,615	--	1,087	1,087	73,702
Wis. "	76,931	54,377	94,964	226,272	32	5,788	5,820	232,092
Mich. "	2,725	241	45,136	48,102	--	32,563	32,563	80,665
Other " 3/	884	--	--	884	--	--	--	--
Total	153,155	54,618	140,100	347,873	32	39,438	39,470	386,459
Birch								
Minn. Mills	--	--	--	--	--	--	--	--
Wis. "	1,252	27,980	7,699	36,931	--	5,061	5,061	41,992
Mich. "	--	--	269	269	--	--	--	269
Total	1,252	27,980	7,968	37,200	--	5,061	5,061	42,261

July 1953

A. G. Horn, Forest Economist

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

(Over)

Species and destination	Production by States 1/				Imports			Total receipts
	Minn.	Wis.	Mich.	Region	U.S. 2/	Canada	Total	
	Standard Cords (rough wood basis)							
Hemlock								
Minn. mills	--	--	--	--	--	--	--	--
Wis. "	--	51,329	68,750	120,079	--	--	--	120,079
Mich. "	--	--	100,200	100,200	--	--	--	100,200
Total	--	51,329	168,950	220,279	--	--	--	200,279
Pine								
Minn. mills	179,033	--	--	179,033	--	61,854	61,854	240,887
Wis. "	156,818	98,461	20,390	275,669	99,190	52,906	152,096	427,765
Mich. "	3,956	3,140	82,392	89,488	--	44,678	44,678	134,166
Total	339,807	101,601	102,782	544,190	99,190	159,438	258,628	802,818
Spruce								
Minn. mills	144,109	--	--	144,109	--	57,948	57,948	202,057
Wis. "	125,486	30,103	77,542	233,131	38,292	405,999	444,291	677,422
Mich. "	2,518	351	32,271	35,140	937	72,170	73,107	108,247
Other " 3/	7,940	--	--	7,940	--	--	--	--
Total	280,053	30,454	109,813	420,320	39,229	536,117	575,346	987,726
Tamarack								
Minn. Mills	9,174	--	--	9,174	--	--	--	9,174
Wis. "	8,756	1,179	69	10,004	192	--	192	10,196
Mich. "	--	--	--	--	--	--	--	--
Total	17,930	1,179	69	19,178	192	--	192	19,370
Misc. hdwds.								
Minn. mills 4/	1,341	--	--	1,341	--	--	--	1,341
Wis. "	--	16,911	1,578	18,489	--	--	--	18,489
Mich. "	--	--	32,572	32,572	--	--	--	32,572
Total	1,341	16,911	34,150	52,402	--	--	--	52,402
All species								
Minn. mills	633,665	10,850	--	644,515	--	178,344	178,344	822,859
Wis. "	424,907	550,534	491,244	1,466,685	137,772	492,866	630,638	2,097,323
Mich. "	9,199	3,732	398,206	411,137	937	170,304	171,241	582,378
Other " 3/	8,824	--	45,570	54,394	--	--	--	--
Total	1,076,595	565,116	935,020	2,576,731	138,709	841,514	980,223	3,502,560

1/ Vertical column of figures under box heading "Production by States" represents the amount of pulpwood cut in each state.
2/ Western wood.
3/ Pulpwood produced in region and shipped out.
4/ Balsam poplar (Balm-of-Gilead).

TECHNICAL NOTES
LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 399

1952 Lake States Pulpwood Production Continues at High Level

The 1952 cut of pulpwood in the Lake States was the second highest on record according to a survey recently completed by the Station. A summary of reports from pulp mills drawing wood from the region shows that they received approximately 2,280,000 cords. This was 12 percent less than the all-time high of 2,577,000 cords produced in 1951.

Of the 1952 total, Minnesota produced about 41 percent, Michigan 33 percent, and Wisconsin 26 percent. Despite the rise and fall of pulpwood production during the past six or seven years each state has produced about the same proportion of the regional total each year.

Spruce was the leading species making up nearly one-third of the wood received by Lake States mills. However, spruce was exceeded by aspen in wood cut in the Lake States region. More than half of the spruce used came from Canada.

With the exception of spruce and balsam fir, the production of all species showed a decrease from the previous year. Of the principal species pine and hemlock showed the greatest decline.

Total imports from Canada and the western states were about the same as in 1951. Canadian spruce shipments increased slightly but those of most other species declined. Shipments of lodgepole pine from the western states showed a sizable increase in contrast to a sharp decline in western spruce shipments.

Production and Imports of Pulpwood, Lake States - 1952

Species and destination	Production by States 1/				Imports			Total Receipts
	Minn.	Wis.	Mich.	Region	U.S.2/	Canada	Total	
	Standard Cords (rough wood basis)							
Aspen								
To Minnesota	234,502	6,467	--	240,969	--	60,752	60,752	301,721
Wisconsin	35,490	269,032	170,664	475,186	--	14,736	14,736	489,922
Michigan	--	--	85,343	85,343	--	16,767	16,767	102,110
Exported 3/	--	--	19,009	19,009	--	--	--	--
Total	269,992	275,499	275,016	820,507	--	92,255	92,255	893,753
Balsam fir								
To Minnesota	62,043	--	--	62,043	--	240	240	62,283
Wisconsin	101,224	75,795	105,909	282,928	26	4,573	4,599	287,527
Michigan	--	--	46,490	46,490	--	21,674	21,674	68,164
Total	163,267	75,795	152,399	391,461	26	26,487	26,513	417,974

July 1953

A. G. Horn, Forest Economist

MAINTAINED BY THE U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

(Over)

Species and destination	Production by States 1/				Imports			Total receipts
	Minn.	Wis.	Mich.	Region	U.S. 2/	Canada	Total	
Birch								
To Minnesota	19	--	--	19	--	--	--	19
Wisconsin	2,323	14,627	8,387	25,337	--	6,599	6,599	31,936
Michigan	--	--	--	--	--	603	603	603
Total	2,342	14,627	8,387	25,356	--	7,202	7,202	32,558
Hemlock								
To Minnesota	--	--	--	--	--	--	--	--
Wisconsin	--	63,681	67,173	130,854	--	--	--	130,854
Michigan	--	2,112	57,694	59,806	--	--	--	59,806
Total	--	65,793	124,867	190,660	--	--	--	190,660
Pine								
To Minnesota	104,969	125	--	105,094	--	48,719	48,719	153,813
Wisconsin	87,436	91,934	13,341	192,711	128,736	43,707	172,443	365,154
Michigan	1,288	2,857	44,737	48,882	--	31,720	31,720	80,602
Total	193,693	94,916	58,078	346,687	128,736	124,146	252,882	599,569
Spruce								
To Minnesota	142,060	--	--	142,060	--	49,086	49,086	191,146
Wisconsin	150,491	38,910	86,473	275,874	2,865	453,332	456,197	732,071
Michigan	125	--	33,533	33,658	1,496	80,587	82,083	115,741
Total	292,676	38,910	120,006	451,592	4,361	583,005	587,366	1,038,958
Tamarack								
To Minnesota	8,874	--	--	8,874	--	141	141	9,015
Wisconsin	3,857	1,412	197	5,466	225	--	225	5,691
Michigan	--	--	--	--	--	--	--	--
Total	12,731	1,412	197	14,340	225	141	366	14,706
Misc. Hardwds								
To Minnesota 4/	2,042	--	--	2,042	--	--	--	2,042
Wisconsin	--	15,000	496	15,496	--	--	--	15,496
Michigan	--	--	22,359	22,359	--	--	--	22,359
Total	2,042	15,000	22,855	39,897	--	--	--	39,897
All Species								
To Minnesota	554,509	6,592	--	561,101	--	158,938	158,938	720,039
Wisconsin	380,821	570,391	452,640	1,403,852	131,852	522,947	654,799	2,058,651
Michigan	1,413	4,969	290,156	296,538	1,496	151,351	152,847	449,385
Exported 3/	--	--	19,009	19,009	--	--	--	--
Total	936,743	581,952	761,805	2,280,500	133,348	833,236	966,584	3,228,075

1/ Vertical column of figures under box heading "Production by States" represents the amount of pulpwood cut in each state.

2/ Western States.

3/ Pulpwood produced in region and shipped out.

4/ Balsam poplar (Balm-of-Gilead.)

TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · · FOREST SERVICE
UNIVERSITY FARM ST. PAUL 1, MINNESOTA

No. 400

Hypoxylon Canker of Aspen in the Lake States

A cooperative study of Hypoxylon canker, a serious disease of aspen, made during 1949-51 by Federal and State agencies and industrial forest owners on 211 plots in the three Lake States indicated the following:

1. Incidence of the disease is not correlated with site index, tree vigor, or any of the environmental factors studied which influence tree vigor.

2. Greater damage is evident on poor sites, apparently because the slower growing trees there are exposed to infection longer before reaching merchantable size, and not because of a higher annual rate of infection. Furthermore, at any given age, full stocking on poor sites requires more trees per acre; consequently, in aspen stands of equal initial density on poor and good sites the same rate of stem depletion would cause greater damage on the poor sites.

3. There is a strong inverse correlation between stand density and canker incidence. Cankered trees are more common in stands with less than 70 percent of full stocking, probably because exposed trees are more susceptible to infection. In low density stands cankers are distributed in a random manner on the stems, but in high density stands the cankers tend to be concentrated on the upper parts of the stems.

4. Cankers tend to face certain directions more than others, the direction varying from area to area in the region. This may indicate that the degree of exposure of the bark to some weather factor is important.

5. Incidence of infection is lowest in pure aspen stands and increases as the proportion of other species in the stand goes up, especially when the other species component is an understory of hardwoods.

Some practical conclusions for aspen management, from the standpoint of Hypoxylon canker damage, are--stands on poor sites should be converted to species better adapted to such sites as soon as possible and stands on better sites should be maintained at 70 percent or more of full stocking. This stocking level is appreciably higher than previously recommended. However, reducing aspen density below 70 percent of full stocking may not be serious in intensively managed stands where most of the infected trees may be salvaged during frequent light thinnings. Further work must be done to determine the stocking level that provides the best compromise between canker loss and maximum growth rate.

Recommended minimum stocking for aspen by diameter classes 1/

Avg. d.b.h. (inches)	2.5	3.0	4.0	5.0	6.0	7.0	8.0
Trees per acre	1600	1175	800	600	450	350	275

1/ Seventy percent of full stocking, derived from Minn. Agr. Exp. Sta. Tech. Bul. 39, 1934.

RALPH L. ANDERSON, Assistant Pathologist
U.S. Bureau Pl. Industry, Soils, & Agr. Eng.

July 1953
MAINTAINED IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA